Pearson Edexcel

International A Level Science

Understanding Assessment and Improving Delivery in IAL Chemistry

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Pearson Edexcel

Aims and objectives

- introduce the concept of assessment objectives: what are they and why they are used when writing examination papers
- analyse recent question papers and learn which types of questions match the different assessment objectives
- investigate different assessment objectives, considering how questions have been answered by looking at feedback from the previous exam series
- discuss strategies for teaching to help students access questions targeting different assessment objectives
- review the support Pearson offers for teaching the qualification

Today's Agenda

- Introduction to Assessment Objectives (AOs)
- Why AOs are assigned in question papers
- Assigning AOs to questions
- AO2: feedback and strategies for teaching
- AO3: feedback and strategies for teaching
- Support

UNDERSTANDING ASSESSMENT

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

Definitions of AOs

		% in IAS	% in IA2	% in IAL
AO1	Demonstrate knowledge and understanding of science.	34–36	29–31	32–34
AO2 (a)	Application of knowledge and understanding of science in familiar and unfamiliar contexts.	34–36	33–36	33–36
(b)	Analysis and evaluation of scientific information to make judgements and reach conclusions.	9–11	14–16	11–14
AO3	Experimental skills in science, including analysis and evaluation of data and methods.	20	20	20

Specification p75

Linking AO1 to command words

Demonstrate knowledge and understanding of science

Recall facts and reasons

Example of command words:

Add/Label

Complete/Record

Describe (straightforward known ideas)

Explain (a simple idea or reason)

Give/State/Name

Write (a familiar equation)

Linking AO2(a) to command words

Application of knowledge and understanding of science in familiar and unfamiliar contexts

Apply facts and reasons to contexts

Example of command words:

Assess

Criticise

Deduce

Evaluate

Explain (for more complex ideas)

Suggest

Linking AO2(b) to command words

Analysis and evaluation of scientific information to make judgements and reach conclusions

Use information to explain facts and reasons or use information with facts and reasons to establish new ideas

Example of command words:

Assess

Criticise

Deduce

Evaluate

Explain (for more complex ideas)

Suggest

Linking AO3 to command words

Experimental skills in science, including analysis and evaluation of data and methods

Practical skills including recall of some key practical activities

Explanation for the steps involved may be looked at in both familiar and unfamiliar contexts as will the evaluation of data and methods

Any of the command words might be used

Typical AO1 question

Propan-1-ol may be converted into propene.

$$CH_3CH_2CH_2OH \rightarrow CH_3CH{=}CH_2 + H_2O$$

Which reagent is used for this reaction?

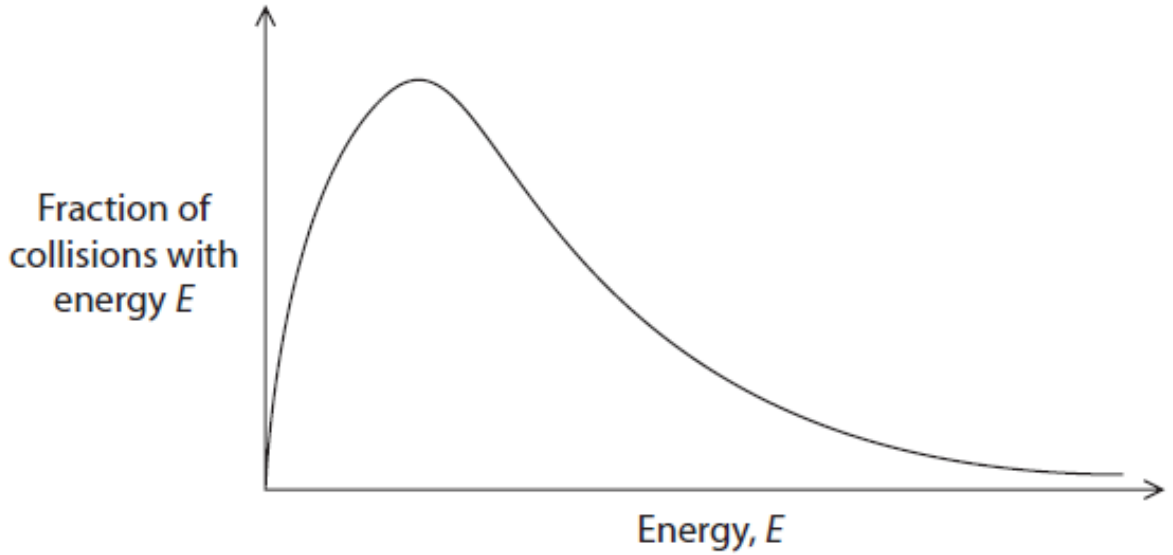
- ☒ **A** 50% sulfuric acid
- ☒ **B** ethanolic potassium hydroxide
- ☒ **C** phosphoric(V) acid
- ☒ **D** red phosphorus

Typical AO1 questions

Methanal is used in the production of many materials and chemical compounds. It is manufactured from methanol by reaction with oxygen at 300–400 °C using an iron-molybdenum oxide catalyst.

$$CH_3OH(g) + \tfrac{1}{2}O_2(g) \rightarrow HCHO(g) + H_2O(g)$$

(a) The Maxwell–Boltzmann distribution for the reaction mixture at 300 °C is shown.



(i) On the diagram, sketch the Maxwell–Boltzmann distribution for this reaction mixture at a **higher** temperature. (1)

(ii) Using the Maxwell–Boltzmann distributions, explain why increasing the temperature and adding a catalyst both increase the rate of reaction. (2)

Typical AO2a question

Which compound has the greatest covalent character?

- ☒ **A** $MgBr_2$
- ☒ **B** MgF_2
- ☒ **C** NaBr
- ☒ **D** NaF

Typical AO2a question

Barium chloride, $BaCl_2$, can be prepared by the reaction of barium carbonate with hydrochloric acid.

$$BaCO_3(s) + 2HCl(aq) \rightarrow BaCl_2(aq) + CO_2(g) + H_2O(l)$$

Write the ionic equation for this reaction.
State symbols are not required.

(1)

Typical AO2b question

0.15 mol of aluminium is added to 120 cm^3 of 1.50 mol dm^{-3} hydrochloric acid.

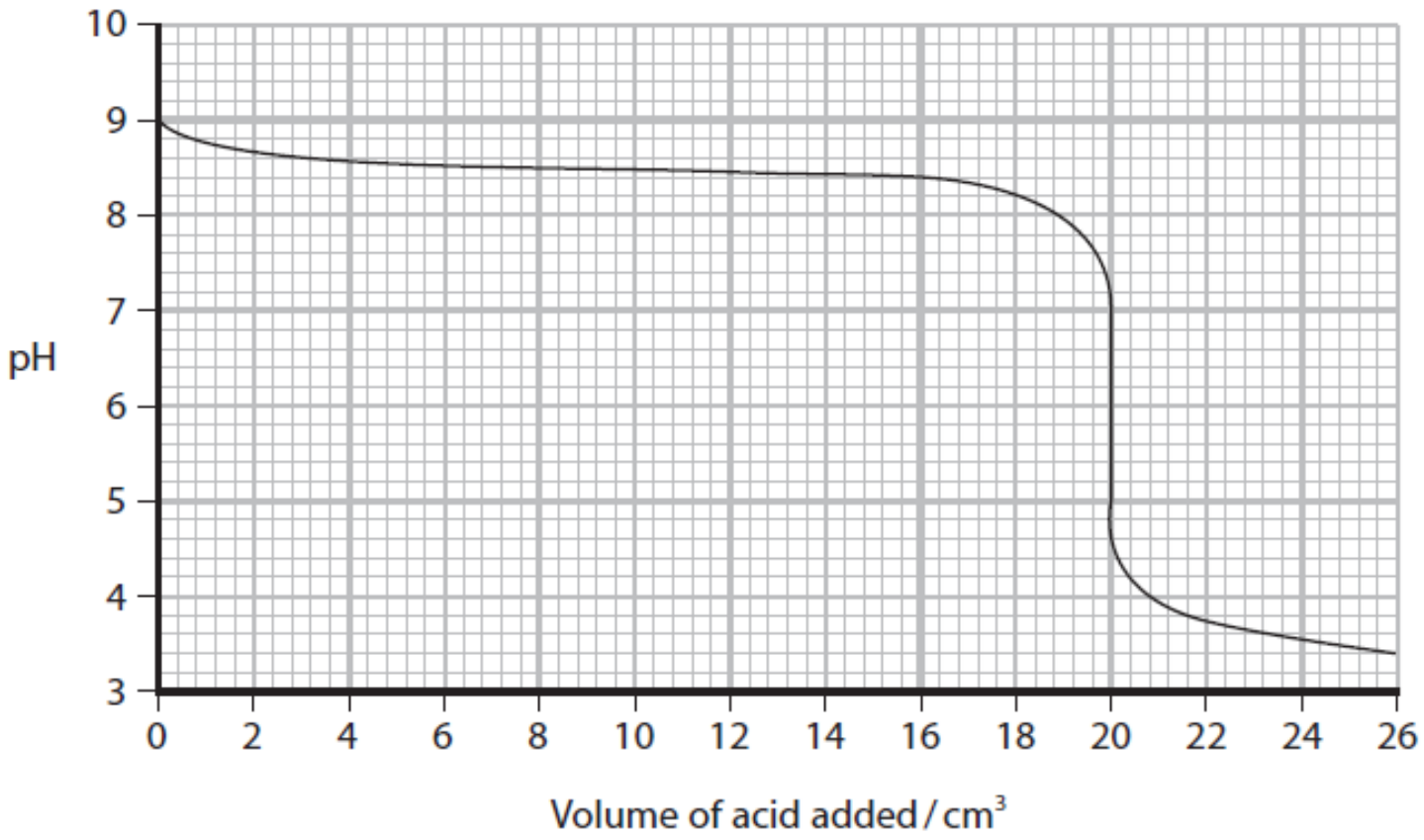
$$2Al(s) + 6H^+(aq) \rightarrow 2Al^{3+}(aq) + 3H_2(g)$$

The amount of **unused** reactant is

- ☒ **A** 0.06 mol aluminium
- ☒ **B** 0.09 mol aluminium
- ☒ **C** 0.03 mol hydrochloric acid
- ☒ **D** 0.13 mol hydrochloric acid

Typical AO2b question

A titration curve of Tris with chloroethanoic acid is shown.



Explain how this graph shows Tris and its conjugate acid act as a buffer.

ACTIVITY 1

ACTIVITY 1 – Assigning AOs

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

ACTIVITY 1 – Assigning AOs

This question is about bond angles.

(a) What is the expected bond angle in a boron trichloride molecule, BCl_3?

☒ **A** 90° ☒ **B** 107° ☒ **C** 109.5° ☒ **D** 120°

(b) What is the expected bond angle in an ammonium ion?

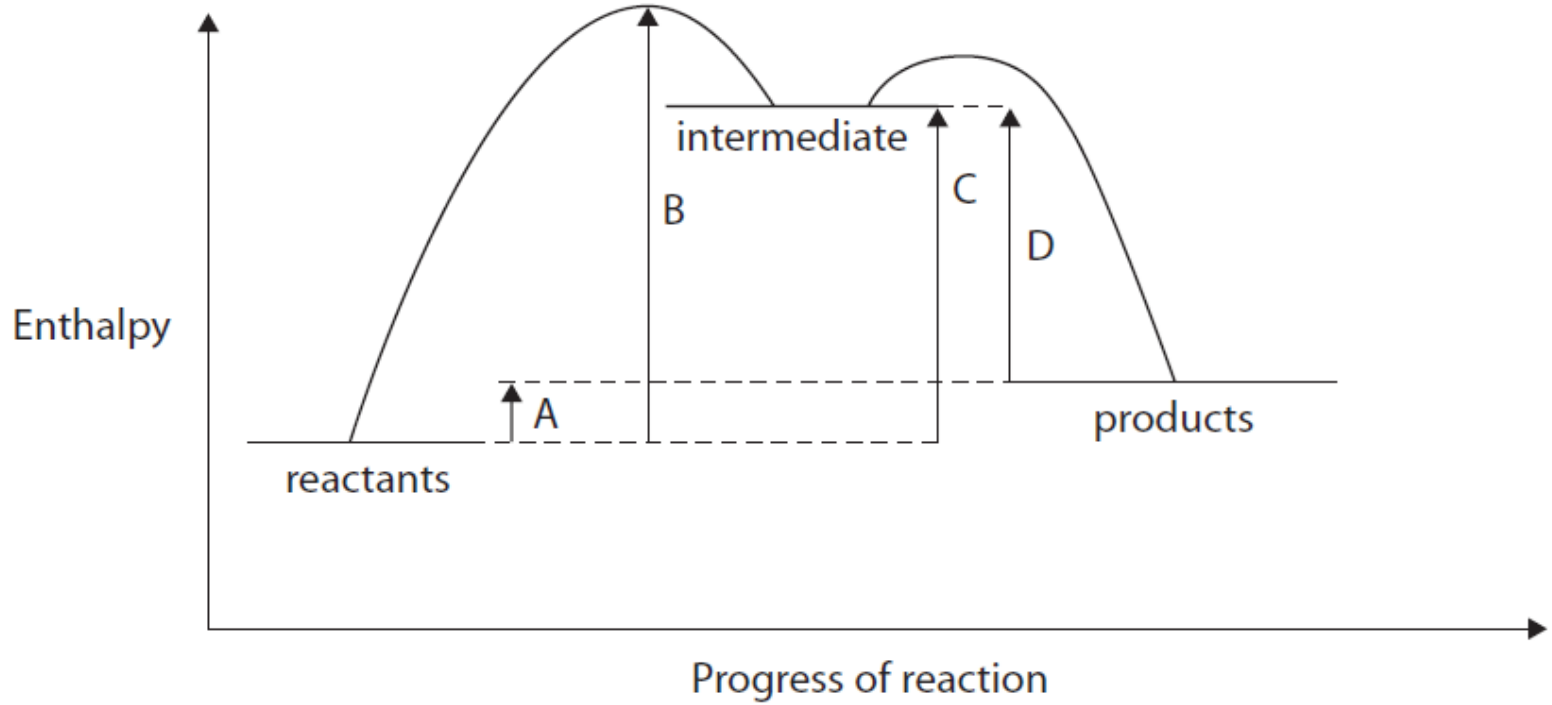
☒ **A** 90° ☒ **B** 104.5° ☒ **C** 107° ☒ **D** 109.5°

(c) What is the expected bond angle in an oxygen difluoride molecule, OF_2?

☒ **A** 90° ☒ **B** 104.5° ☒ **C** 109.5° ☒ **D** 180°

ACTIVITY 1 – Assigning AOs

An enthalpy level diagram for a reaction with an intermediate is shown.



Which arrow shows the enthalpy change for this reaction?

- ☒ **A** arrow A
- ☒ **B** arrow B
- ☒ **C** arrow C
- ☒ **D** arrow D

ACTIVITY 1 – Assigning AOs

This question is about silicon.

(a) (i) Define relative atomic mass. **(2)**

(ii) Calculate the relative atomic mass of a sample of silicon, using the isotopic abundance data provided.
Give your answer to 3 significant figures.

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

(2)

(iii) In the mass spectrum of silicon, there is also a small peak at $m/z = 14$.
Deduce the formula of this particle. **(1)**

ACTIVITY 1 – 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.

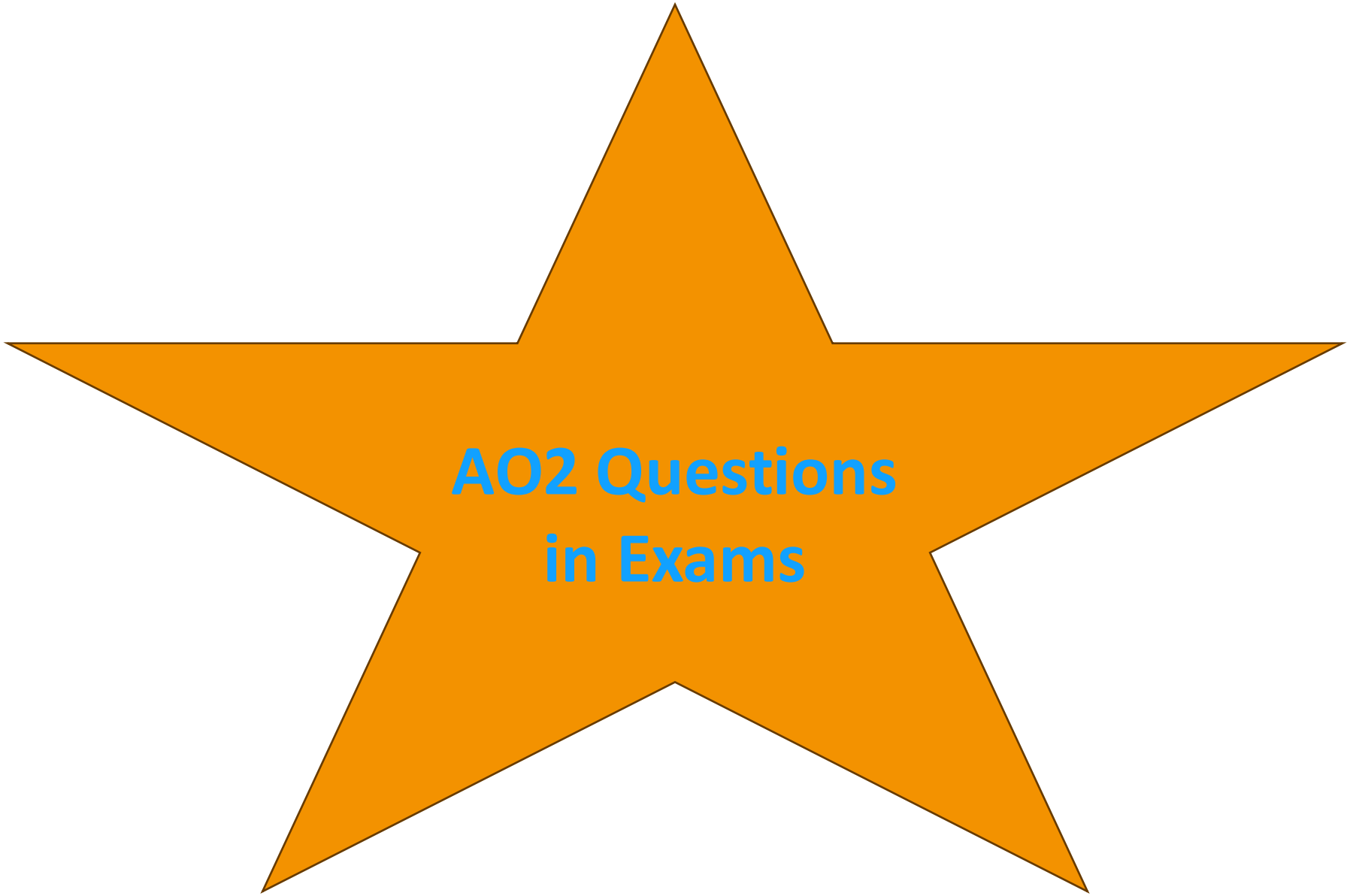
Step **6** The bromoethane was purified.

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. **(1)**

(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. **(1)**

(c) Explain why an orange colour was seen in the round-bottomed flask when it was first gently heated in Step **4**. **(2)**


AO2 Questions
in Exams

Why not look at AO1?

- AO1 is all about knowledge – and basic understanding
- This is not something 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 2

ACTIVITY 2 – 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 2 – 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 2 – AO2a in exams

Student 1

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

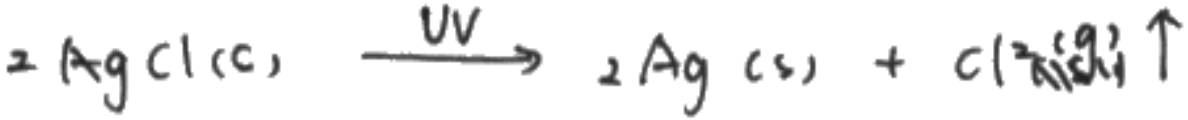
Student 2

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

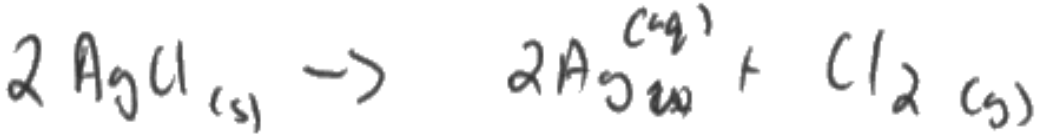
Answer	Additional Guidance
An answer that makes reference to the following points: • correctly balanced equation **(1)** • state symbols **(1)**	$2AgCl(s) \rightarrow 2Ag(s) + Cl_2(g)$ M2 dependent on M1 or near miss e.g. $AgCl_2$ or correct formulae but unbalanced equation

ACTIVITY 2 – AO2a in exams

Student 3



Student 4



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ACTIVITY 2 – 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 2 – AO2a in exams

Student 1

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

$\simeq 28.159\%$

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 2 – AO2a in exams

Student 2

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

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 2 – 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 2 – AO2a in exams

Student 4

~~28 x 91.~~

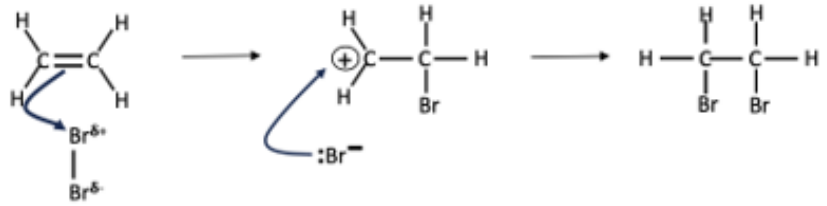
28 x 0.9107 + 29 x 0.0462 + 30 x 0.03 + 32 x 0.0131 = 28.2

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 2 – AO2a in exams

Using the simplest alkene as an example, draw the mechanism to show the reaction with liquid bromine.

(4)

Answer	Additional Guidance
An answer that makes reference to the following points: • dipole on Br–Br • arrow from double bond to delta + bromine • arrow from bromine bond to delta - bromine • carbocation on correct intermediate • lone pair on bromide • negative charge on bromide ion • arrow from lone pair on bromide ion to carbocation • correct formula of final product (1,2-dibromoethane) all 8 points 4 marks, 6 or 7 points 3 marks, 4 or 5 points 2 marks, 2 or 3 points 1 mark	 Point 1 if H-Br used penalise here only Point 4 carbocation intermediate based on any alkene Point 7 given for the arrow from lone pair if given, or anywhere if lone pair not given. Comment: the same error is penalised only once

ACTIVITY 2 – AO2a in exams

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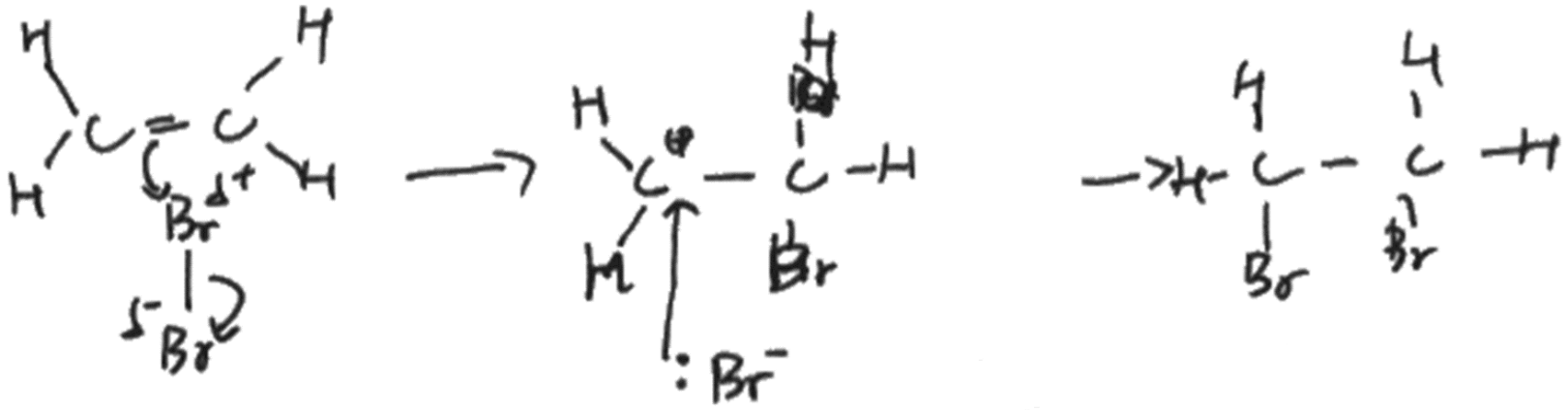

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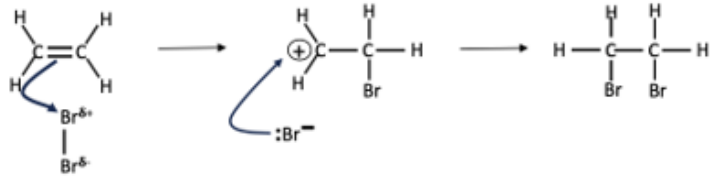
An answer that makes reference to the following points: • dipole on Br–Br • arrow from double bond to delta + bromine • arrow from bromine bond to delta - bromine • carbocation on correct intermediate • lone pair on bromide • negative charge on bromide ion • arrow from lone pair on bromide ion to carbocation • correct formula of final product (1,2-dibromoethane) all 8 points 4 marks, 6 or 7 points 3 marks, 4 or 5 points 2 marks, 2 or 3 points 1 mark	 Point 1 if H-Br used penalise here only Point 4 carbocation intermediate based on any alkene Point 7 given for the arrow from lone pair if given, or anywhere if lone pair not given. Comment: the same error is penalised only once

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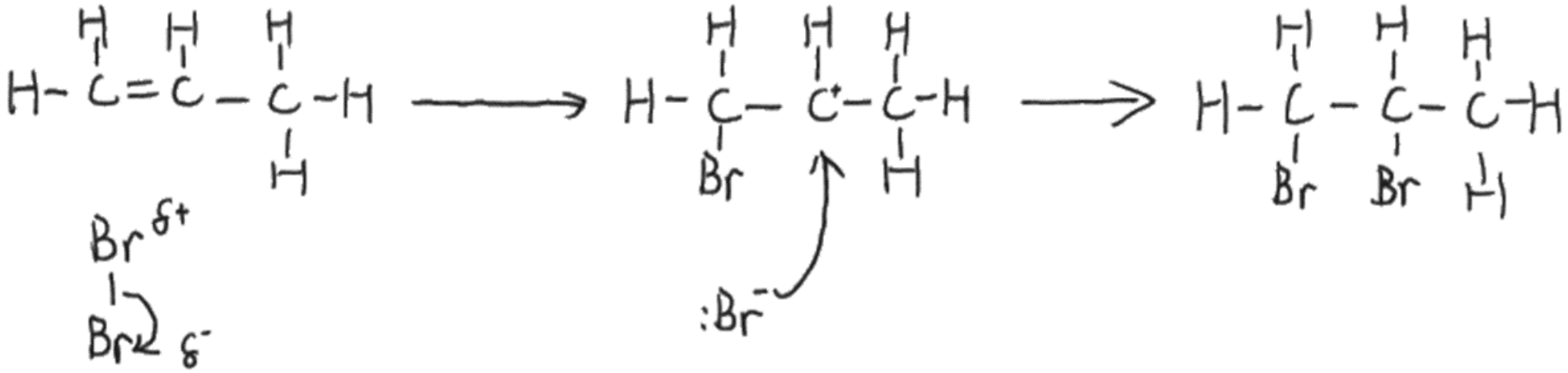

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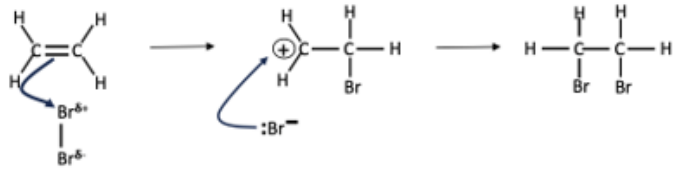
An answer that makes reference to the following points: • dipole on Br–Br • arrow from double bond to delta + bromine • arrow from bromine bond to delta - bromine • carbocation on correct intermediate • lone pair on bromide • negative charge on bromide ion • arrow from lone pair on bromide ion to carbocation • correct formula of final product (1,2-dibromoethane) all 8 points 4 marks, 6 or 7 points 3 marks, 4 or 5 points 2 marks, 2 or 3 points 1 mark	 Point 1 if H-Br used penalise here only Point 4 carbocation intermediate based on any alkene Point 7 given for the arrow from lone pair if given, or anywhere if lone pair not given. Comment: the same error is penalised only once

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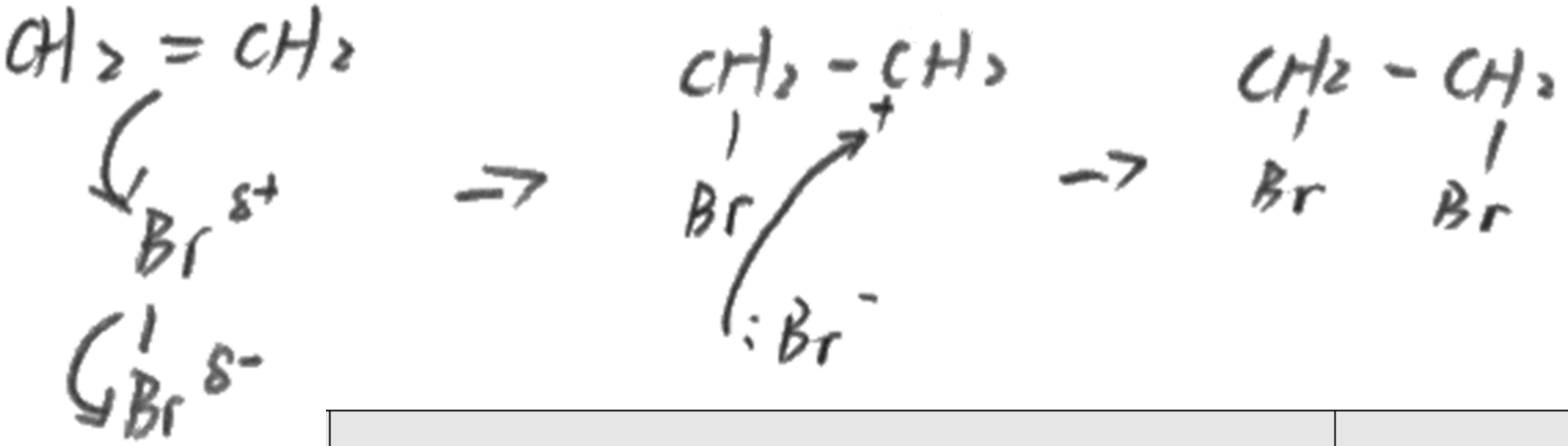

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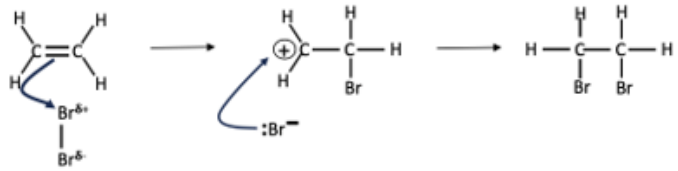
An answer that makes reference to the following points: • dipole on Br–Br • arrow from double bond to delta + bromine • arrow from bromine bond to delta - bromine • carbocation on correct intermediate • lone pair on bromide • negative charge on bromide ion • arrow from lone pair on bromide ion to carbocation • correct formula of final product (1,2-dibromoethane) all 8 points 4 marks, 6 or 7 points 3 marks, 4 or 5 points 2 marks, 2 or 3 points 1 mark	 Point 1 if H-Br used penalise here only Point 4 carbocation intermediate based on any alkene Point 7 given for the arrow from lone pair if given, or anywhere if lone pair not given. Comment: the same error is penalised only once

ACTIVITY 2 – AO2a in exams

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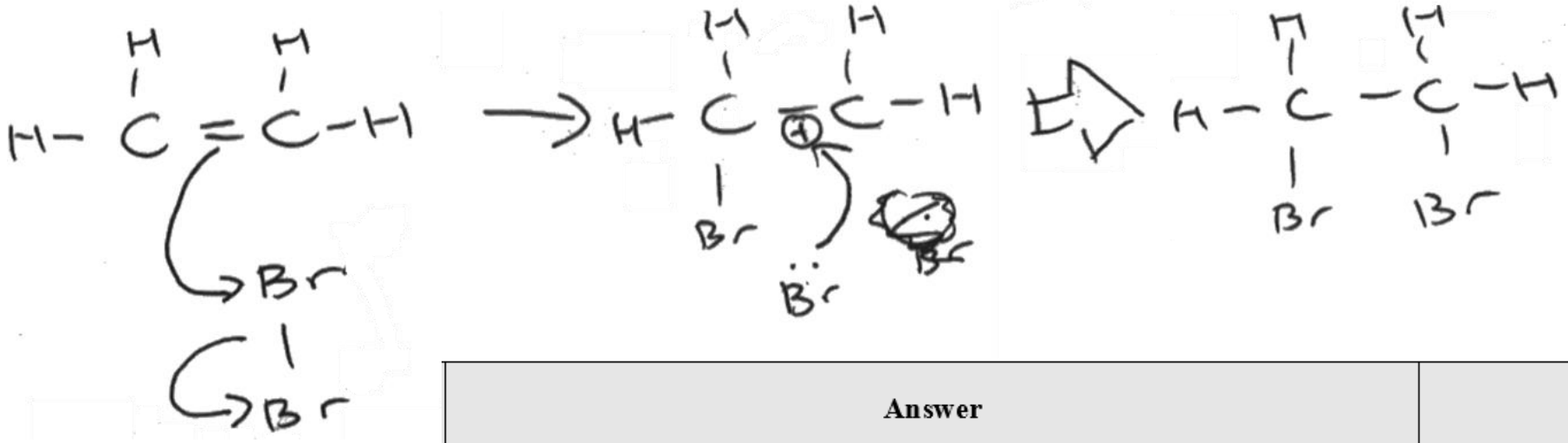

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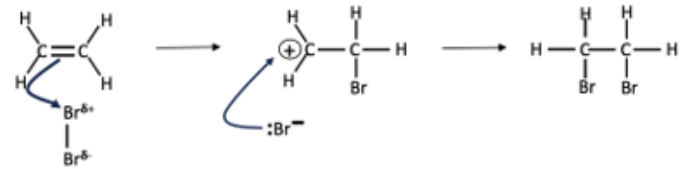
An answer that makes reference to the following points: • dipole on Br–Br • arrow from double bond to delta + bromine • arrow from bromine bond to delta - bromine • carbocation on correct intermediate • lone pair on bromide • negative charge on bromide ion • arrow from lone pair on bromide ion to carbocation • correct formula of final product (1,2-dibromoethane) all 8 points 4 marks, 6 or 7 points 3 marks, 4 or 5 points 2 marks, 2 or 3 points 1 mark	 Point 1 if H-Br used penalise here only Point 4 carbocation intermediate based on any alkene Point 7 given for the arrow from lone pair if given, or anywhere if lone pair not given. Comment: the same error is penalised only once

ACTIVITY 3

Activity 3 – AO2b in exams

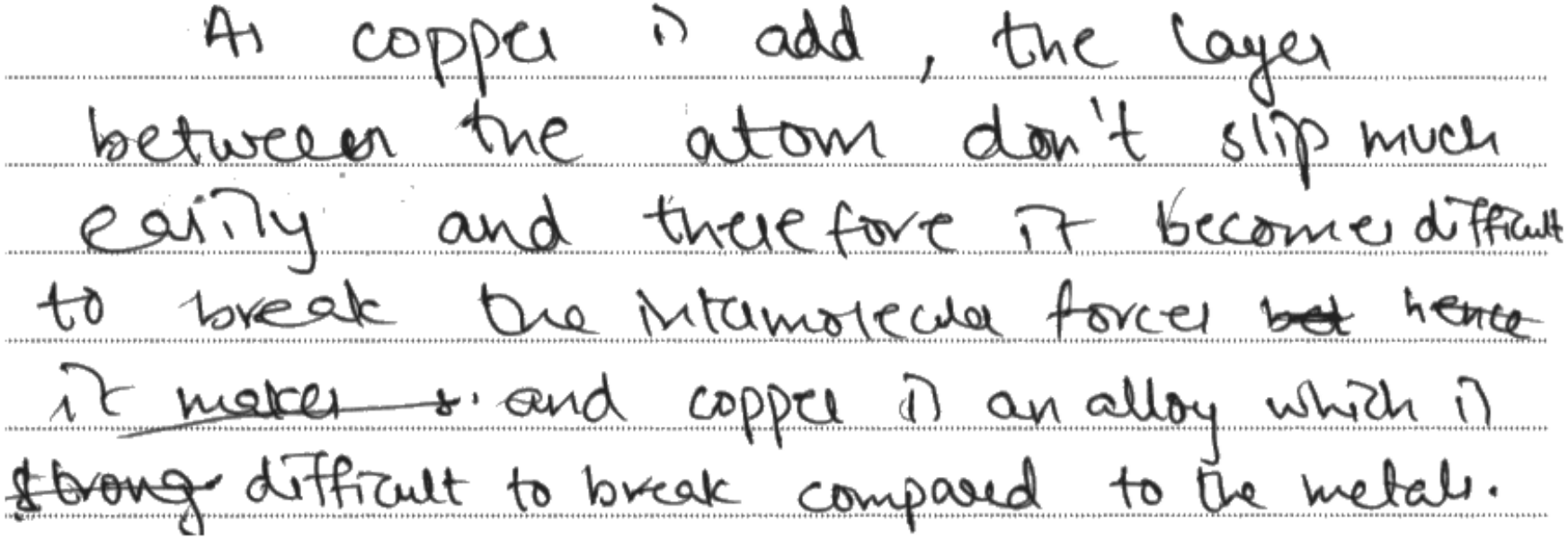
Pure silver cups are too soft so small amounts of copper are added to make an alloy.

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 3 – AO2b in exams

Student 1



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Activity 3 – AO2b in exams

Student 2

an alloy has different size of cations, which makes them harder to slide over each other, ~~and~~ because hence increases 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)
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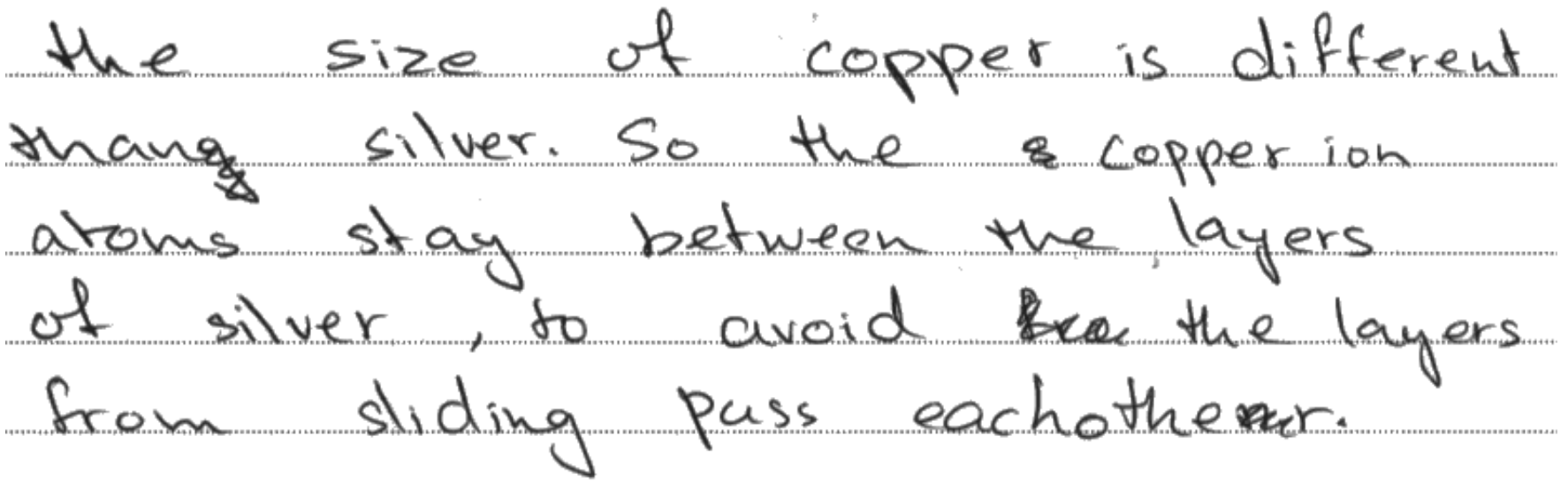
Activity 3 – AO2b in exams

Student 3



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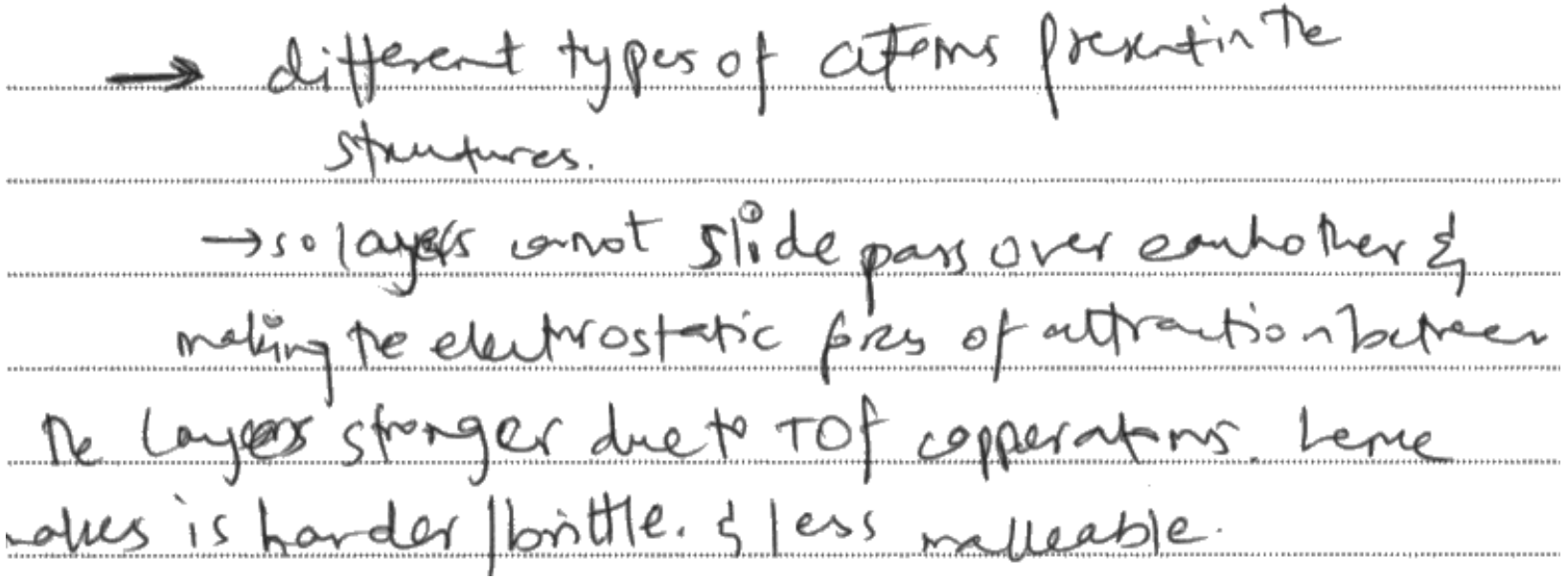
Activity 3 – AO2b in exams

Student 4



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IMPROVING
DELIVERY
in
AO2

Teaching and Learning Strategies

- Focus on understanding the requirements of questions looking carefully at what marks are awarded for
- Students should practice examination questions focusing on the use of mark schemes to understand the requirements of the questions
- Look at the wording of the question to identify where the context needs to be addressed (AO2) rather than simply facts and statements (AO1)

Organic mechanisms

A significant difference between (International) GCSE and IAL Organic Chemistry is the requirement to write mechanisms

Organic mechanisms

Preliminary knowledge:

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

Organic mechanisms

Before you add the curly arrows:

- make sure that the structures of the reactants are clearly shown

- focus on the key features of the reactants, for example:
  - functional groups
  - relevant dipoles
  - lone pairs

- encourage students to describe what they think might happen

Organic mechanisms

Now you are ready to add the curly arrows

- Annotate the mechanisms to emphasise understanding

- Consider using colours to emphasise different aspects of the mechanism

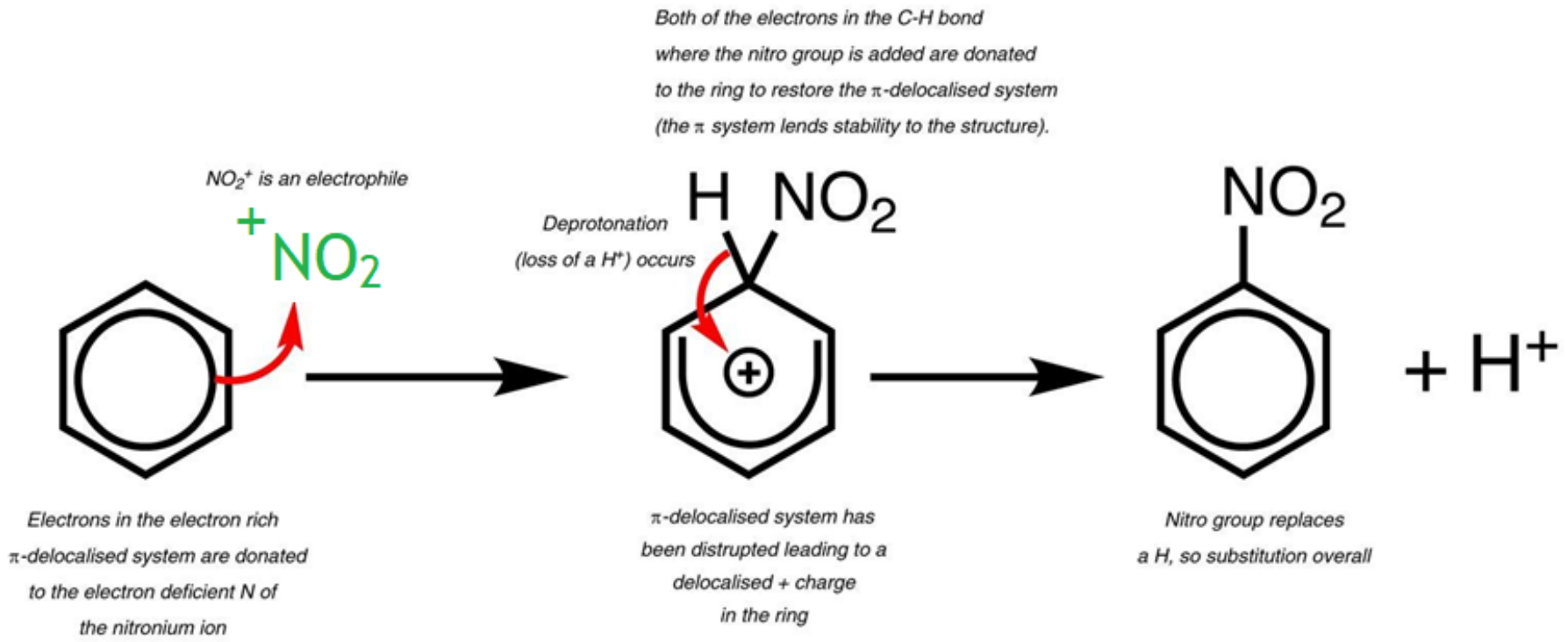
  E.g. red for curly arrows

  blue for nucleophiles

  green for electrophiles

Organic mechanisms

Example of annotation



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

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
- Consider using ‘Jigsaw’ tasks
- Try to make time in lessons to adopt more of a ‘coaching’ role, than a ‘director’ role
- C3B4UCM

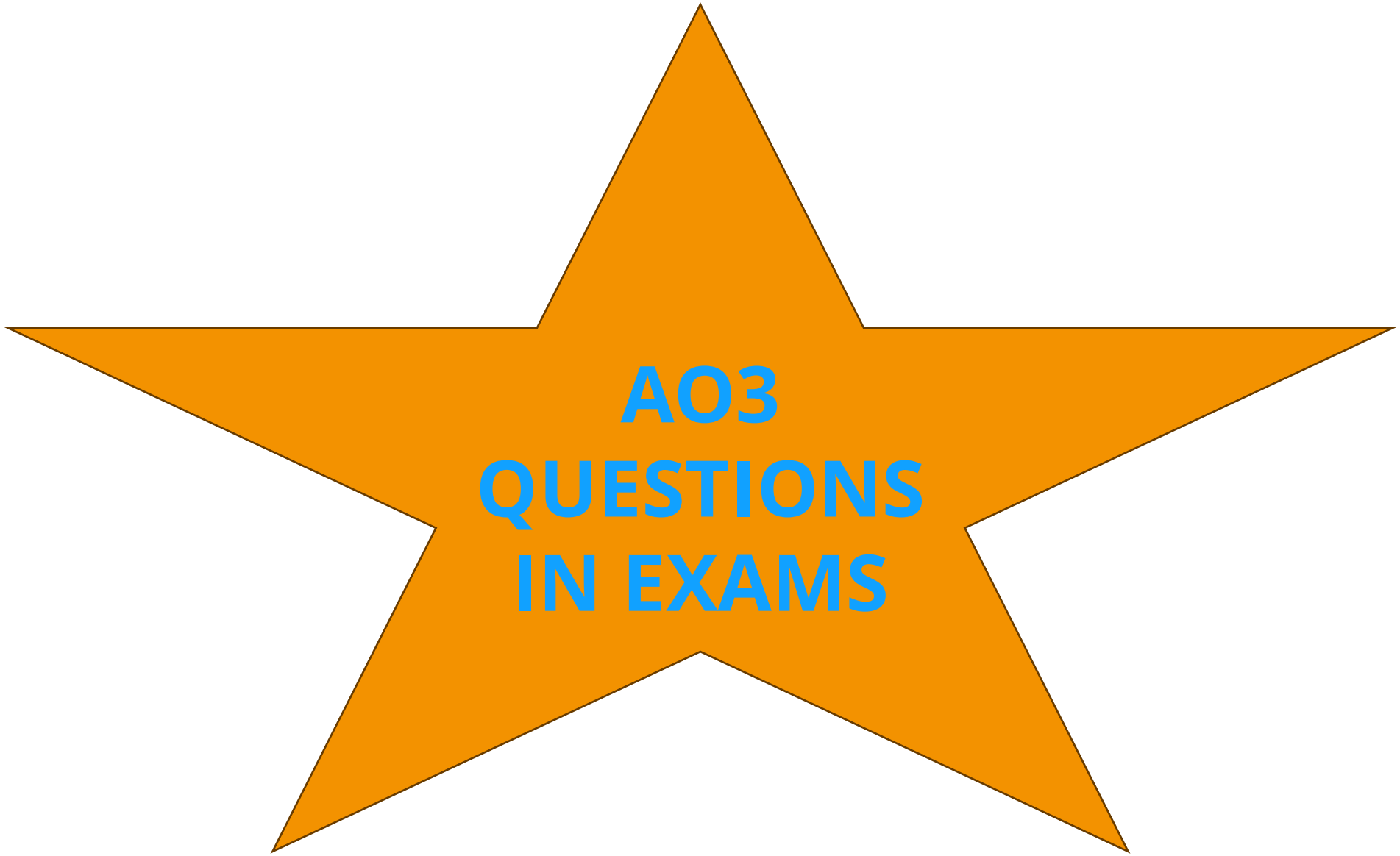
Building more independent learners

- Consider using ‘Snowball’ techniques to develop an explanation

  This encourages peer to peer discussion / collaboration

- Provide access to reference material – hard copy or online

- Use open questioning


AO3
QUESTIONS
IN EXAMS

Why do we ask AO3?

- While AO1 is focused on recall of knowledge and explanation and AO2 focuses on application, analysis and evaluation, AO3 is placed in a practical context

- Practical work is an important part of Chemistry A level and a student's familiarity with practical techniques is tested in AO3

- The practical work may be familiar or unfamiliar, but questions will focus on techniques and concepts

Types of Questions

- All the questions in papers WCH13 (Unit 3) and WCH16 (Unit 6)

- Many questions are similar to the questions from equivalent papers in the previous specification

AO3 in exams

Use the mark schemes shown on screen to mark the student responses on the following slides

We will go through each question one at a time

AO3 in exams

The equilibrium between iodine(I) chloride, chlorine and iodine(III) chloride can be used to demonstrate the effects of changing conditions on a system at equilibrium.

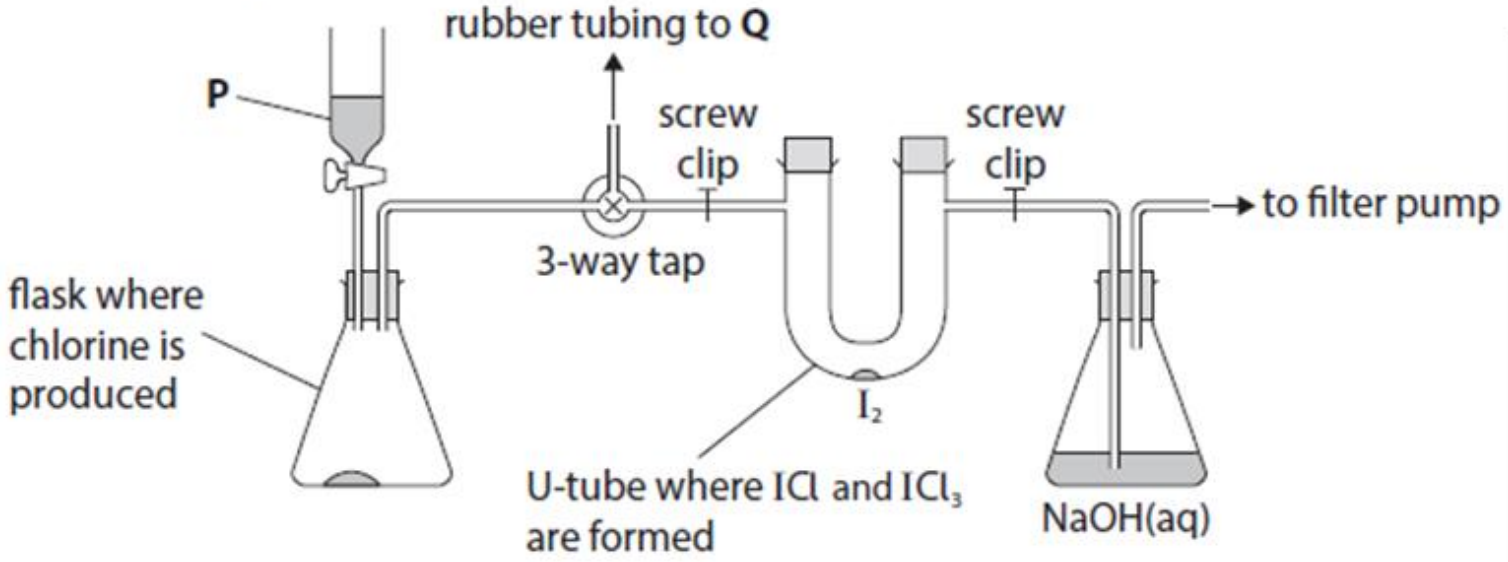
Iodine(I) chloride is formed by passing chlorine over iodine in a U-tube.
The equation for this is shown.

$$I_2 + Cl_2 \rightarrow 2ICl$$

A further reaction then occurs between the iodine(I) chloride and chlorine which results in the equilibrium shown.

$$\underset{\text{brown}}{ICl(l)} + \underset{\text{pale green}}{Cl_2(g)} \rightleftharpoons \underset{\text{yellow}}{ICl_3(s)} \qquad \Delta H = -106\,\text{kJ mol}^{-1}$$

The apparatus shown can be used to set up and then to demonstrate how the system at equilibrium responds to changing conditions.



AO3 in exams

(a) The addition of more liquid **P** to the flask on the left produces more chlorine gas.

(i) Explain the observations you would make as the amount of chlorine gas in the U-tube increases. (3)

Answer		Additional Guidance
An explanation that makes reference to the following points:		
		Ignore references to fizzing/bubbles/green gas Ignore references to heat/enthalpy change
(Observations) • (more) brown liquid forms (of ICl)	**(1)**	Ignore references to a subsequent decrease after an increase/more is stated
• (then more) yellow solid forms (ICl_3)	**(1)**	Allow precipitate/ppt for solid Allow 1 mark for M1 and M2 for goes brown then yellow without states and in the correct order
(Reasoning) • because the **equilibrium** position shifts to the right (due to the increase in chlorine gas)	**(1)**	Allow **equilibrium** shifts to the products/ICl_3 Standalone mark

AO3 in exams

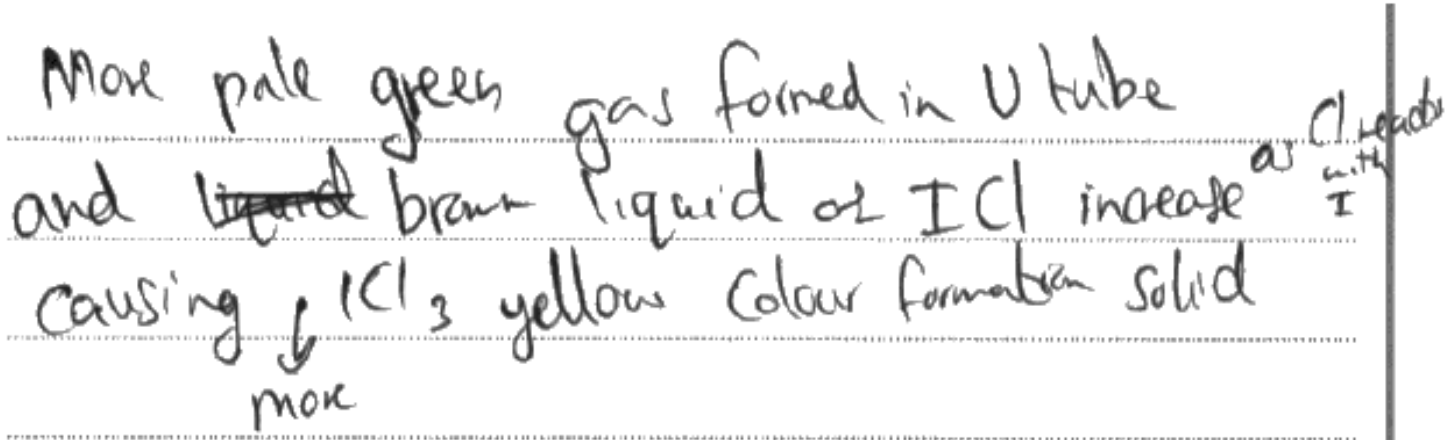
Student 1

More ICl and ICl_3 will be produced because more liquid P will produce more chlorine so more ICl and

Answer		Additional Guidance
An explanation that makes reference to the following points:		
(Observations)		Ignore references to fizzing/bubbles/green gas Ignore references to heat/enthalpy change
• (more) brown liquid forms (of ICl)	**(1)**	Ignore references to a subsequent decrease after an increase/more is stated
• (then more) yellow solid forms (ICl_3)	**(1)**	Allow precipitate/ppt for solid Allow 1 mark for M1 and M2 for goes brown then yellow without states and in the correct order
(Reasoning)		
• because the **equilibrium** position shifts to the right (due to the increase in chlorine gas)	**(1)**	Allow **equilibrium** shifts to the products/ICl_3 Standalone mark

AO3 in exams

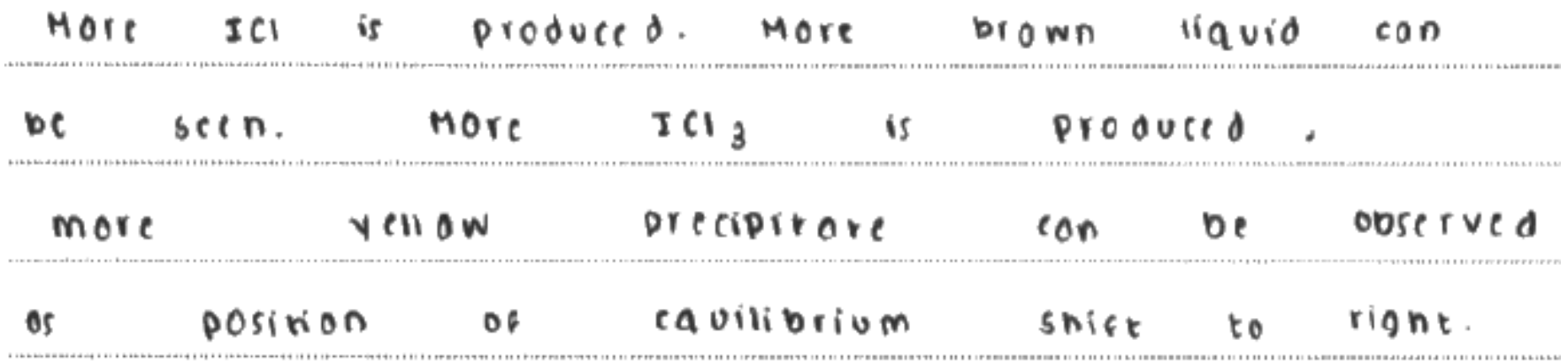
Student 2



Answer		Additional Guidance
An explanation that makes reference to the following points:		Ignore references to fizzing/bubbles/green gas Ignore references to heat/enthalpy change
(Observations) • (more) brown liquid forms (of ICl)	**(1)**	Ignore references to a subsequent decrease after an increase/more is stated
• (then more) yellow solid forms (ICl_3)	**(1)**	Allow precipitate/ppt for solid Allow 1 mark for M1 and M2 for goes brown then yellow without states and in the correct order
(Reasoning) • because the **equilibrium** position shifts to the right (due to the increase in chlorine gas)	**(1)**	Allow **equilibrium** shifts to the products/ICl_3 Standalone mark

AO3 in exams

Student 3



Answer	Additional Guidance
An explanation that makes reference to the following points:	
	Ignore references to fizzing/bubbles/green gas Ignore references to heat/enthalpy change
(Observations) • (more) brown liquid forms (of ICl) **(1)**	Ignore references to a subsequent decrease after an increase/more is stated
• (then more) yellow solid forms (ICl_3) **(1)**	Allow precipitate/ppt for solid Allow 1 mark for M1 and M2 for goes brown then yellow without states and in the correct order
(Reasoning) • because the **equilibrium** position shifts to the right (due to the increase in chlorine gas) **(1)**	Allow **equilibrium** shifts to the products/ICl_3 Standalone mark

AO3 in exams

Student 4

More chlorine gas will react with the iodine to form a brown liquid.

Further addition of chlorine gas causes the brown liquid to form a

yellow solid / precipitate.

Answer		Additional Guidance
An explanation that makes reference to the following points:		Ignore references to fizzing/bubbles/green gas Ignore references to heat/enthalpy change
(Observations) • (more) brown liquid forms (of ICl)	(1)	Ignore references to a subsequent decrease after an increase/more is stated
• (then more) yellow solid forms (ICl_3)	(1)	Allow precipitate/ppt for solid Allow 1 mark for M1 and M2 for goes brown then yellow without states and in the correct order
(Reasoning) • because the **equilibrium** position shifts to the right (due to the increase in chlorine gas)	(1)	Allow **equilibrium** shifts to the products/ICl_3 Standalone mark

AO3 in exams

(a) (ii) The 3-way tap can be used to prevent more chlorine gas from entering the equilibrium system.

Identify **Q** and state why it is necessary. (2)

Answer		Additional Guidance
An explanation that makes reference to the following points:		
• (label) to the fume cupboard / fume hood	(1)	Allow open window/vent Allow reference to aqueous/solution of NaOH Do not award dissolving in water COMMENT Allow 'to the outside'
• because chlorine is toxic/poisonous	(1)	Allow hazardous for toxic Ignore harmful/dangerous/pressure references COMMENT – Allow Cl for chlorine Standalone mark Do not award references to flammability

ACTIVITY 4 – AO3 in exams

Student 1

Q is fume cupboard since chlorine gas is toxic.

Answer		Additional Guidance
An explanation that makes reference to the following points:		
• (label) to the fume cupboard / fume hood	(1)	Allow open window/vent Allow reference to aqueous/solution of NaOH Do not award dissolving in water COMMENT Allow 'to the outside'
• because chlorine is toxic/poisonous	(1)	Allow hazardous for toxic Ignore harmful/dangerous/pressure references COMMENT – Allow Cl for chlorine Standalone mark Do not award references to flammability

ACTIVITY 4 – AO3 in exams

Student 2

- Gas syringe
- To collect chlorine & prevent it from escaping
- Toxic ... safety precaution, Cl_2 is toxic

Answer		Additional Guidance
An explanation that makes reference to the following points:		
• (label) to the fume cupboard / fume hood	(1)	Allow open window/vent Allow reference to aqueous/solution of NaOH Do not award dissolving in water COMMENT Allow 'to the outside'
• because chlorine is toxic/poisonous	(1)	Allow hazardous for toxic Ignore harmful/dangerous/pressure references COMMENT – Allow Cl for chlorine Standalone mark Do not award references to flammability

ACTIVITY 4 – AO3 in exams

Student 3

Fume cupboard is Q. It stops pressure build up which can damage apparatus and doesn't release Cl_2 in the air as its toxic to inhale so disposes of it safely.

Answer		Additional Guidance
An explanation that makes reference to the following points:		
• (label) to the fume cupboard / fume hood	**(1)**	Allow open window/vent Allow reference to aqueous/solution of NaOH Do not award dissolving in water COMMENT Allow 'to the outside'
• because chlorine is toxic/poisonous	**(1)**	Allow hazardous for toxic Ignore harmful/dangerous/pressure references COMMENT – Allow Cl for chlorine Standalone mark Do not award references to flammability

ACTIVITY 4 – AO3 in exams

Student 4

Q is potassium hydroxide. As chlorine gas is toxic it should be absorbed using ~~ether~~ this compound.

Answer		Additional Guidance
An explanation that makes reference to the following points:		
• (label) to the fume cupboard / fume hood	**(1)**	Allow open window/vent Allow reference to aqueous/solution of NaOH Do not award dissolving in water COMMENT Allow 'to the outside'
• because chlorine is toxic/poisonous	**(1)**	Allow hazardous for toxic Ignore harmful/dangerous/pressure references COMMENT – Allow Cl for chlorine Standalone mark Do not award references to flammability

ACTIVITY 4 – AO3 in exams

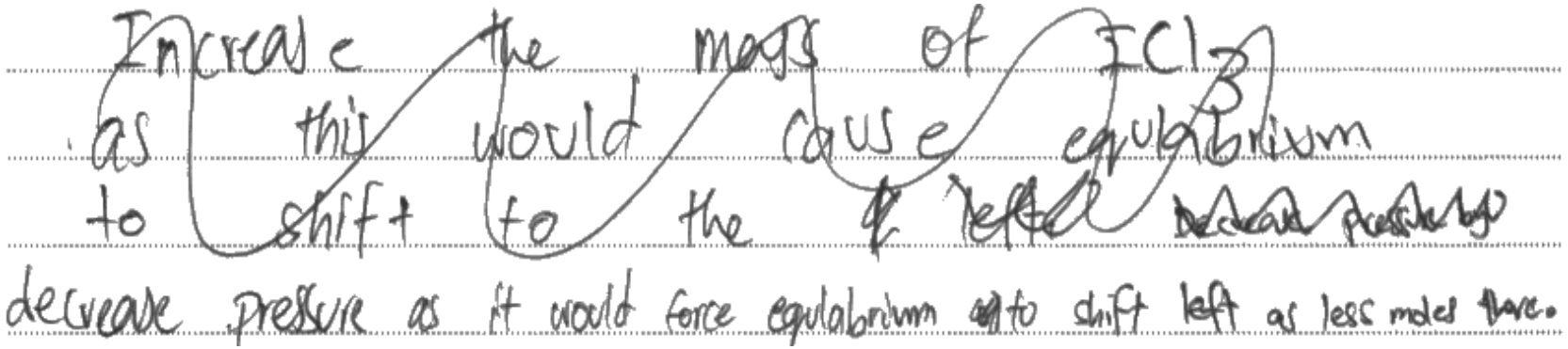
(b) Explain what you could do to the U-tube to result in more brown liquid being observed.

(2)

Answer		Additional Guidance
An explanation that makes reference to the following points:		
• (action) warming/heating the U-tube	(1)	Accept any reasonable means of gently warming the U-tube, e.g. water bath
• because an increase in temperature will shift the equilibrium position to the left (and result in more brown liquid)	(1)	Allow reference to heat shifting the reaction to the left Accept alternative answer: description of turning the U-tube upside down (1) as chlorine gas falls to the bottom and this shifts the equilibrium to the left (1) Ignore references to adding more iodine/changes in pressure

AO3 in exams

Student 1



Answer	Additional Guidance
An explanation that makes reference to the following points:	
• (action) warming/heating the U-tube **(1)**	Accept any reasonable means of gently warming the U-tube, e.g. water bath
• because an increase in temperature will shift the equilibrium position to the left (and result in more brown liquid) **(1)**	Allow reference to heat shifting the reaction to the left Accept alternative answer: description of turning the U-tube upside down (1) as chlorine gas falls to the bottom and this shifts the equilibrium to the left (1) Ignore references to adding more iodine/changes in pressure

AO3 in exams

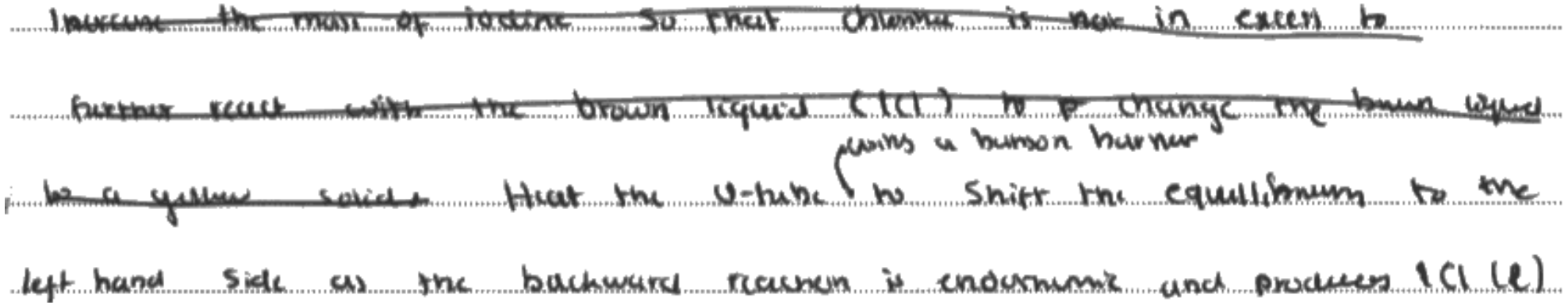
Student 2

- Heat the U-Tube
- Backward reaction is endothermic so high temperature favors it
- More ICl formed

Answer	Additional Guidance
An explanation that makes reference to the following points:	
• (action) warming/heating the U-tube **(1)**	Accept any reasonable means of gently warming the U-tube, e.g. water bath
• because an increase in temperature will shift the equilibrium position to the left (and result in more brown liquid) **(1)**	Allow reference to heat shifting the reaction to the left Accept alternative answer: description of turning the U-tube upside down (1) as chlorine gas falls to the bottom and this shifts the equilibrium to the left (1) Ignore references to adding more iodine/changes in pressure

AO3 in exams

Student 3



Answer	Additional Guidance
An explanation that makes reference to the following points:	
• (action) warming/heating the U-tube **(1)**	Accept any reasonable means of gently warming the U-tube, e.g. water bath
• because an increase in temperature will shift the equilibrium position to the left (and result in more brown liquid) **(1)**	Allow reference to heat shifting the reaction to the left Accept alternative answer: description of turning the U-tube upside down (1) as chlorine gas falls to the bottom and this shifts the equilibrium to the left (1) Ignore references to adding more iodine/changes in pressure

AO3 in exams

Student 4

add more I_2 to prevent all I_2 being used up.

Increase temperature as experiment is exothermic.

Answer		Additional Guidance
An explanation that makes reference to the following points:		
• (action) warming/heating the U-tube	**(1)**	Accept any reasonable means of gently warming the U-tube, e.g. water bath
• because an increase in temperature will shift the equilibrium position to the left (and result in more brown liquid)	**(1)**	Allow reference to heat shifting the reaction to the left Accept alternative answer: description of turning the U-tube upside down (1) as chlorine gas falls to the bottom and this shifts the equilibrium to the left (1) Ignore references to adding more iodine/changes in pressure

AO3 in exams

(c) The sodium hydroxide solution absorbs excess chlorine.

Write the equation for the reaction between cold, dilute sodium hydroxide and chlorine.

State symbols are not required. **(2)**

Answer	Additional Guidance
An answer that makes reference to the following points	Example of equation
• correct species **(1)**	$2NaOH + Cl_2 \rightarrow NaClO + NaCl + H_2O$
	Accept NaOCl for NaClO
• balancing **(1)**	M2 dependent on M1
	Allow multiples
	Ignore state symbols even if incorrect COMMENT Allow (1) for $6NaOH + Cl_2 \rightarrow NaClO_3 + 5NaCl + 3H_2O$

AO3 in exams

Student 1

Answer	Additional Guidance
An answer that makes reference to the following points • correct species **(1)** • balancing **(1)**	Example of equation $2NaOH + Cl_2 \rightarrow NaClO + NaCl + H_2O$ Accept NaOCl for NaClO M2 dependent on M1 Allow multiples Ignore state symbols even if incorrect COMMENT Allow (1) for $6NaOH + Cl_2 \rightarrow NaClO_3 + 5NaCl + 3H_2O$

AO3 in exams

Student 2

$NaOH + 2Cl_2 \rightarrow 2NaCl + 2HCl + O_2$

Answer		Additional Guidance
An answer that makes reference to the following points		Example of equation
• correct species	(1)	$2NaOH + Cl_2 \rightarrow NaClO + NaCl + H_2O$ Accept NaOCl for NaClO
• balancing	(1)	M2 dependent on M1 Allow multiples Ignore state symbols even if incorrect COMMENT Allow (1) for $6NaOH + Cl_2 \rightarrow NaClO_3 + 5NaCl + 3H_2O$

AO3 in exams

Student 3

$2NaOH + Cl_2 \longrightarrow H_2O + NaClO + NaCl$

Answer	Additional Guidance
An answer that makes reference to the following points	Example of equation
• correct species **(1)**	$2NaOH + Cl_2 \rightarrow NaClO + NaCl + H_2O$
	Accept NaOCl for NaClO
• balancing **(1)**	M2 dependent on M1
	Allow multiples
	Ignore state symbols even if incorrect COMMENT Allow (1) for $6NaOH + Cl_2 \rightarrow NaClO_3 + 5NaCl + 3H_2O$

AO3 in exams

Student 4

Answer	Additional Guidance
An answer that makes reference to the following points	Example of equation
• correct species **(1)**	$2NaOH + Cl_2 \rightarrow NaClO + NaCl + H_2O$
	Accept NaOCl for NaClO
• balancing **(1)**	M2 dependent on M1
	Allow multiples
	Ignore state symbols even if incorrect
	COMMENT
	Allow (1) for $6NaOH + Cl_2 \rightarrow NaClO_3 + 5NaCl + 3H_2O$

IMPROVING DELIVERY in AO3

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

As mentioned earlier, 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

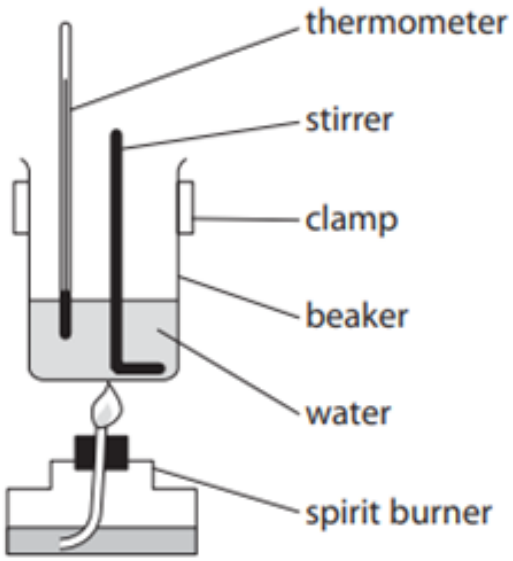
Independent thinking and evaluation

- 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.

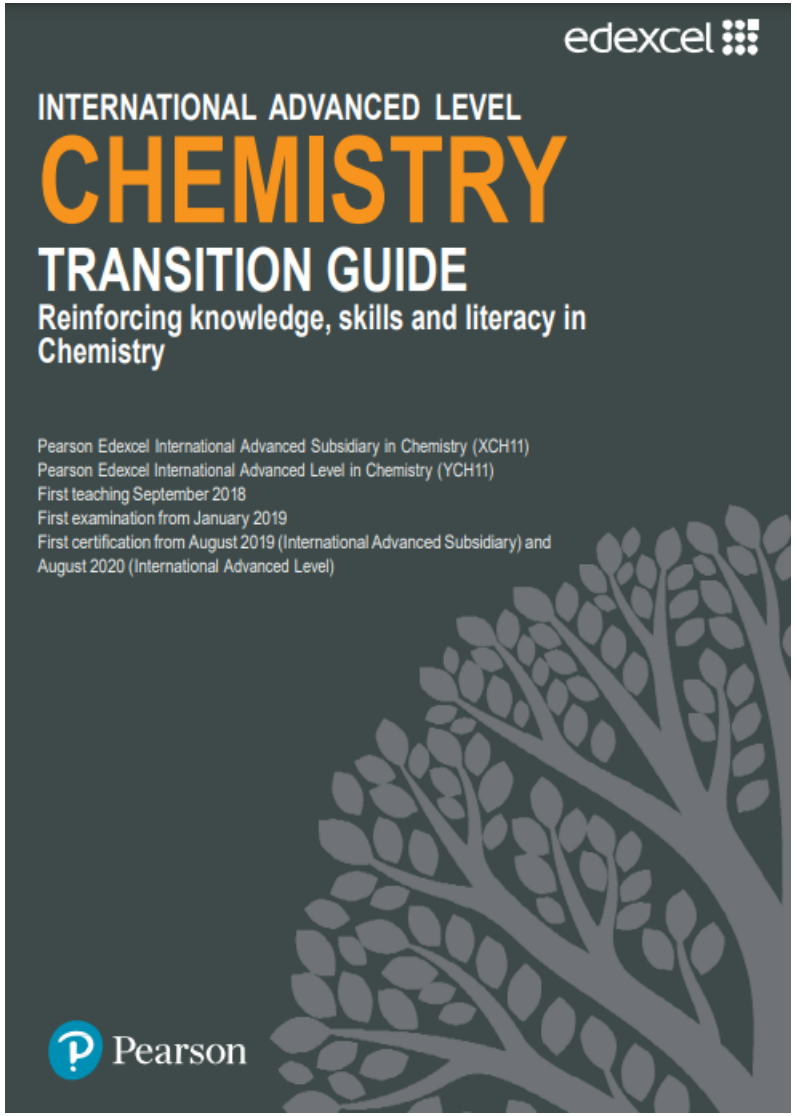
Definition of Terms

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

Stepping up to A Level

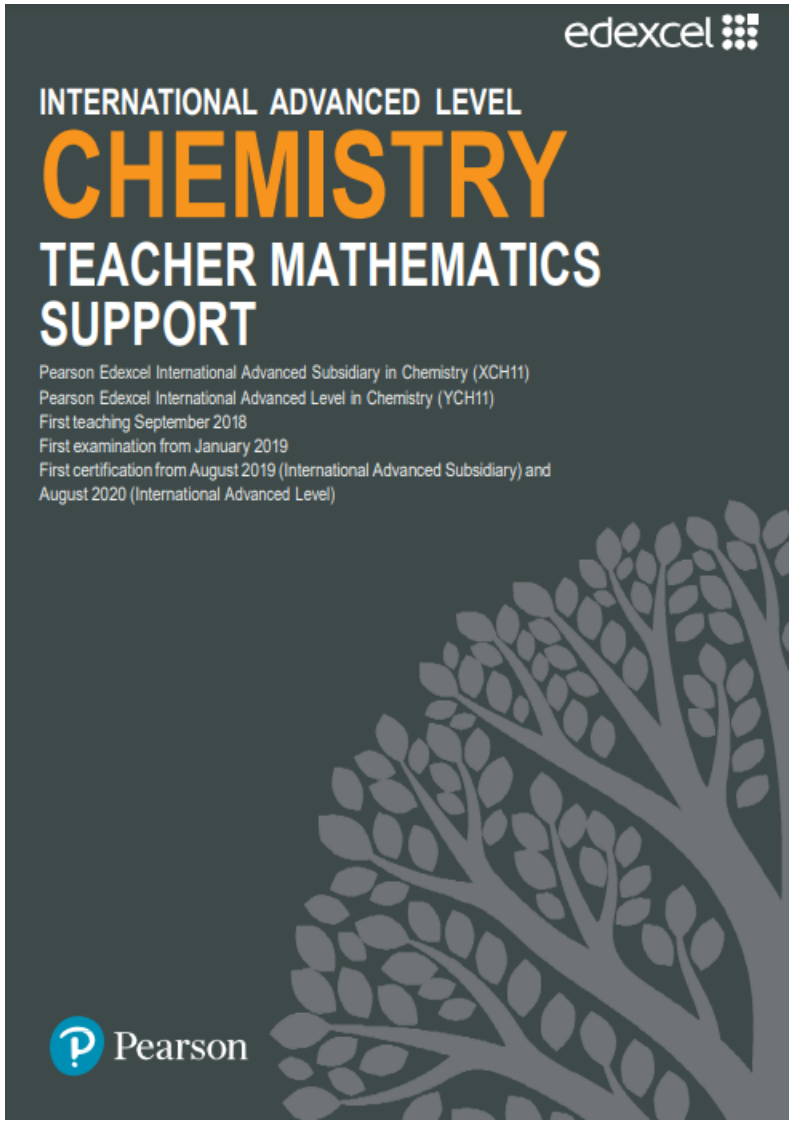


The transition materials include:

- mapping of Edexcel International GCSE(s) to the A Level Chemistry specification
- baseline assessments
- summary sheets
- student worksheets
- practice questions.

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

Maths Support



There is also a student guide that 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

Further help with maths

A number of other resources exist to help students and teachers:

On the Edexcel website, there is a free student workbook:
“Moles, Formulae and Equations”.

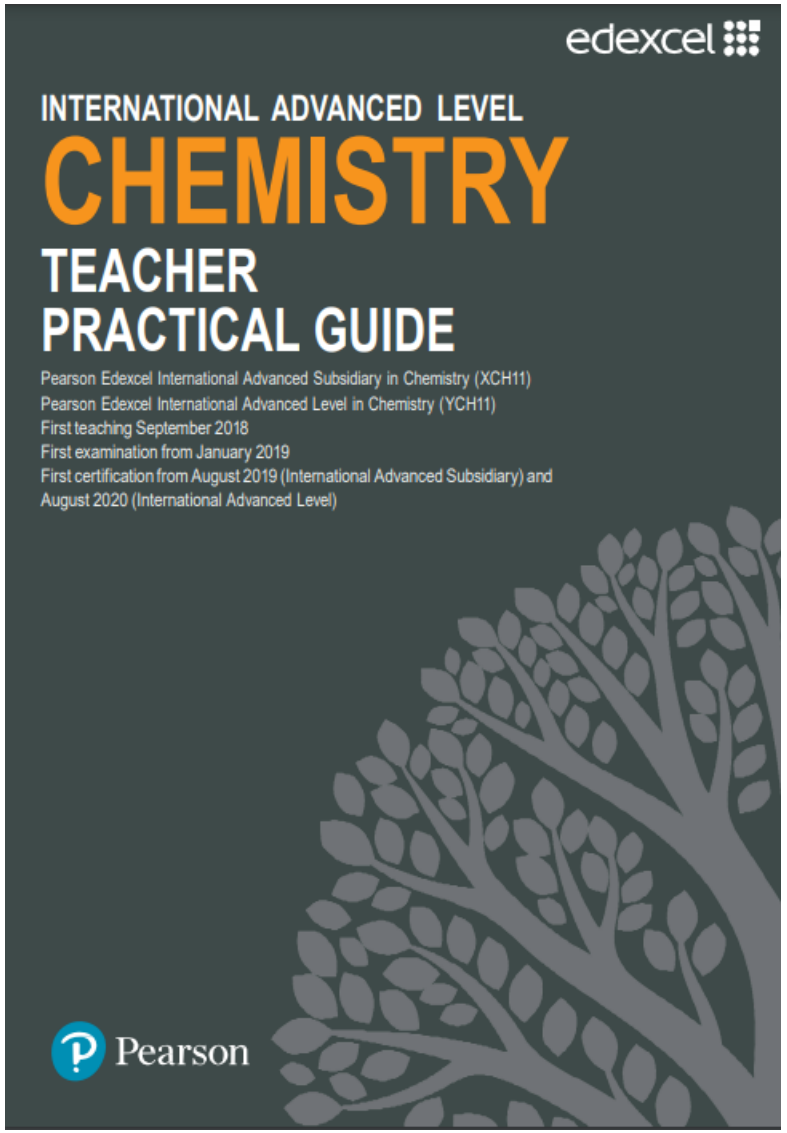
Other useful resources include:

Calculations in AS/A level Chemistry by Jim Clark

Calculations for A level Chemistry by EN Ramsden Maths Skills for A level

Chemistry by Dan McGowan and Emma Poole

Practical Guide

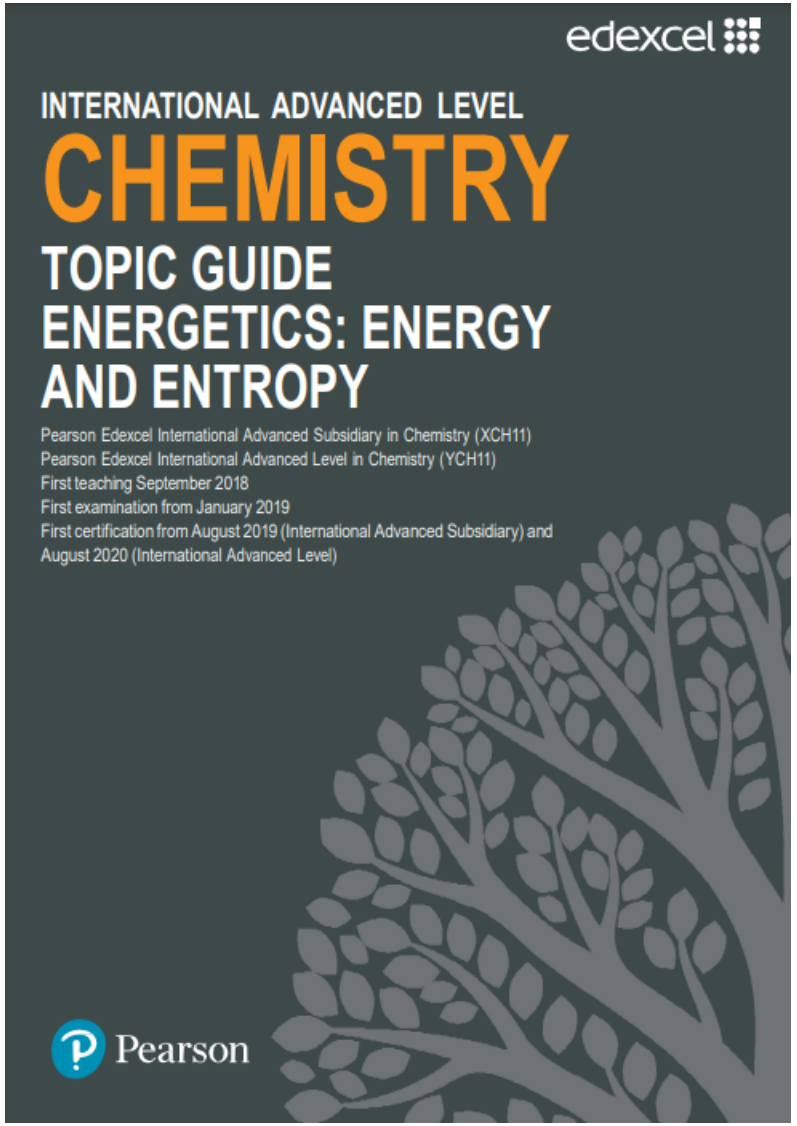


The guide is designed to:

1. support you and your students through all elements of practical work in the new International AS and A level specification. Although it will address assessment arrangements, its focus is to ensure good quality practical work is at the heart of teaching and learning in the subject, and

2. explain how the requirements for practical skills can be developed throughout the course using both core practicals and other specification content.

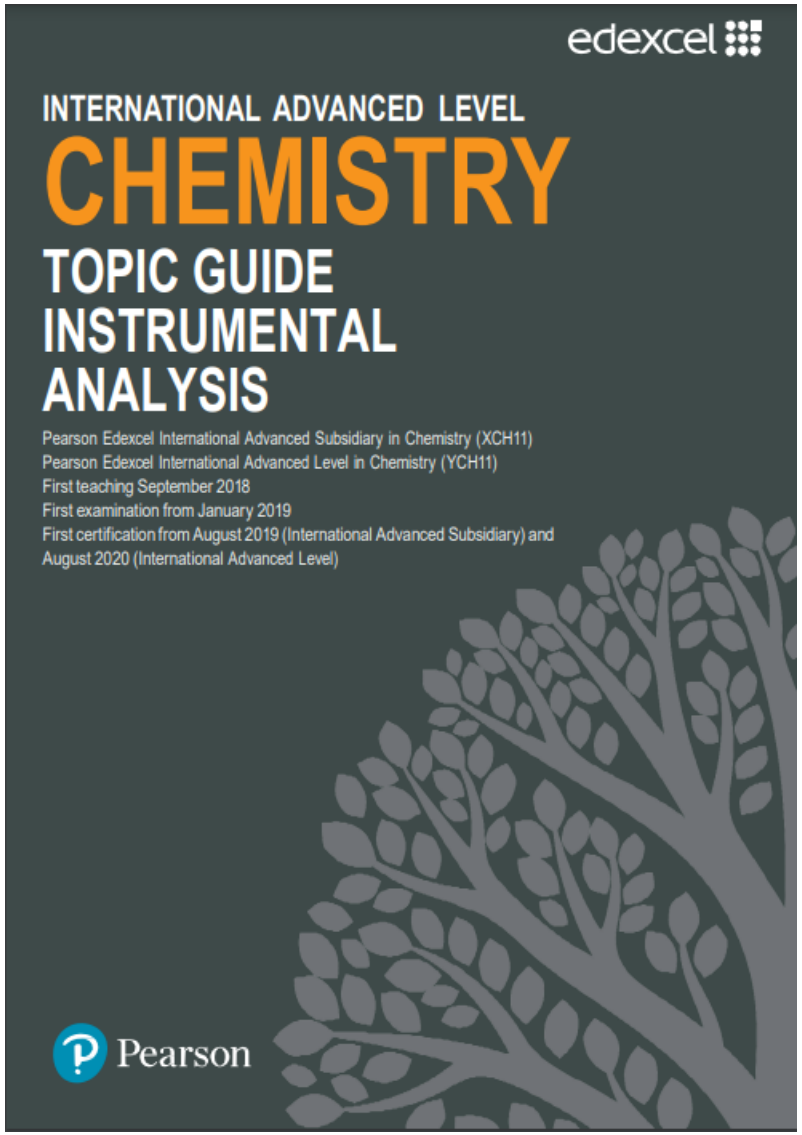
Topic Guide – Energetics: Energy and Entropy



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:

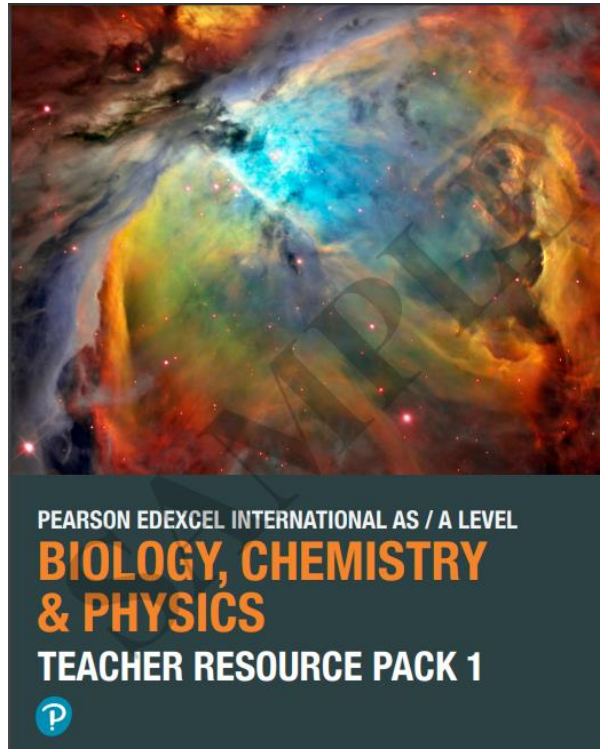
- some ideas on how to address common misconceptions in both new and previously included content
- possible teaching sequences for key specification points where there is new or challenging content
- worked examples which teachers could use to support students in developing their problem-solving skills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

Teacher Resource Packs

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 to the Checkpoint and Exam Practice questions
- Practicals support for core practicals includes student worksheets, exam style questions and teacher and technician notes
- Guide to Thinking Bigger



Types of support available

Online support:

- Teaching and Learning Materials
- Past Papers, Mark Schemes & Examiners' Reports
- Teacher Resource Packs

Published resources:

- Student Books
- Lab Books

Teaching and learning materials

International Advanced Levels
Chemistry (2018)

Pearson | Edexcel

Specification

First teaching: **September 2018**
First external assessment: **2019**

Our International Advanced Subsidiary and Advanced Level Chemistry has been developed to be engaging for international learners and to give them the necessary skills to support progression to higher education or further study in chemistry, as well as to a wide range of other subjects.

DOWNLOAD

PDF | 3.9 MB

Tim Lawrence
Psychology and Science
Email : teachingscience@pearson.com
Phone : +44 (0) 344 463 2535
(Teaching Services team | Mon - Fri, 8am - 5pm GMT)

- **Sign up for subject advisor updates**
- **Visit the customer support portal**
- **Visit your community groups**
- **Book an appointment with your subject advisor**

Register your interest

Find out more about Pearson Edexcel International qualifications and sign up to receive the latest news.

Let us know

Course materials

- **Specification and sample assessments (2)**
- **Exam materials (253)**
- **Teaching and learning materials (41)**

Teaching support and training

- **Training sessions**
- **Results support**
- **Grade boundaries**

Published resources

To support effective classroom delivery, we've developed a range of published resources for the new Edexcel International Advanced Level (IAL), with a strong focus on progression, recognition and transferable skills – allowing learning in a local context to a global standard.

- **Learn more**

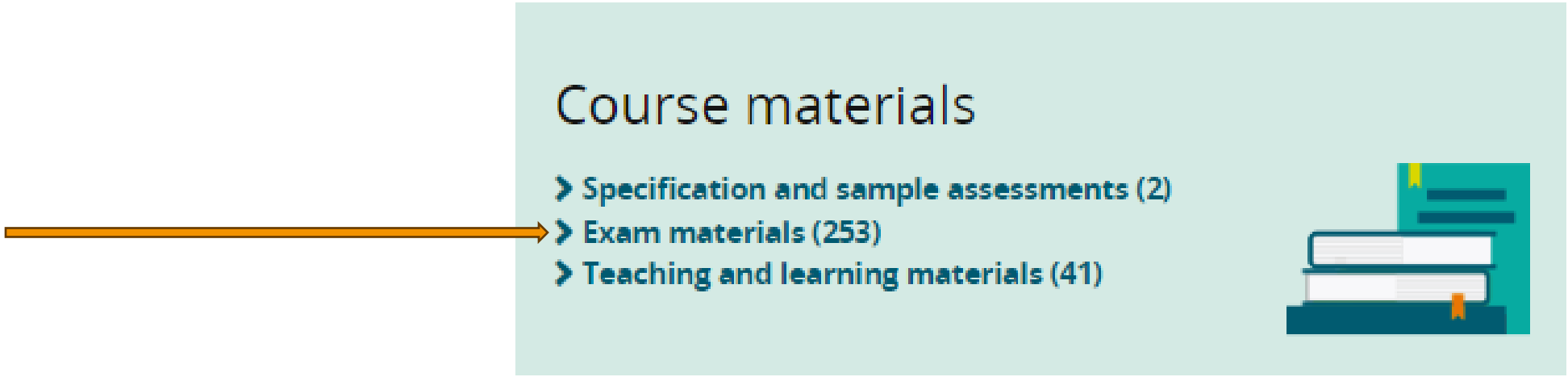
Teaching and learning materials

Exemplar material	*Getting Started Guide*	*Teacher Mathematics Support*
Teacher Practical Guide	*Transition Guide*	Past training content
Scheme of Work	*Topic Guide – Energetics: Energy & Entropy*	*Topic Guide – Instrumental Analysis*

Past papers, Mark Schemes and Examiners Reports

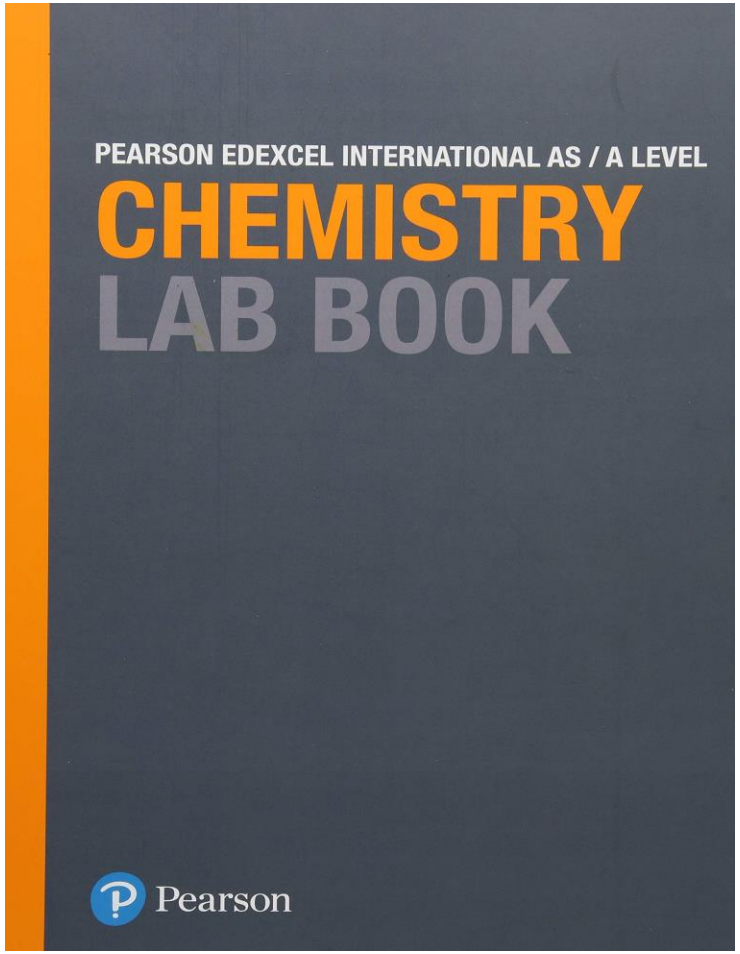
Past papers, mark schemes and examiners reports are also on the Pearson website

They are listed under ‘Exam Materials’ on the ‘Teaching and Learning’ webpage



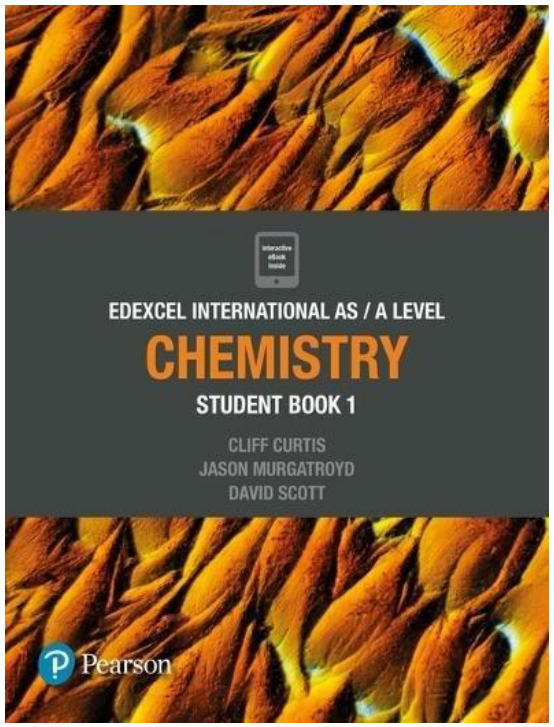
Published resources

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

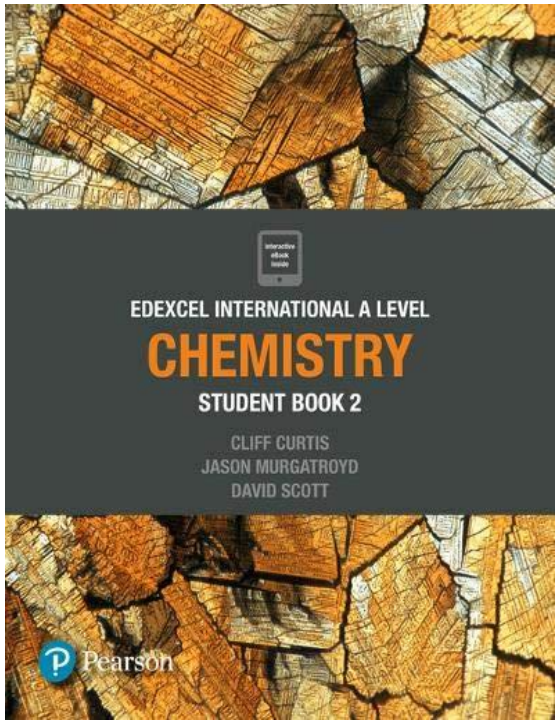


Published resources

Pearson have published two student books to cover the IAS and IAL courses



SB1 covers IAS content



SB2 covers IAL content

Questions

Pearson