Edexcel International AS/A Level

IAL CHEMISTRY

YCH11-20IO3

First teaching in 2018, first assessment 2019

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Aims and objectives

- 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 learn about the support provided by Pearson around assessment and exemplars

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Agenda

Item
Introductions
Question Types
Assessment Objectives
AO2 Questions
BREAK
AO3 Questions
Support

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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

cross in box

line through cross in box

(Total for Question 1 = 1 mark)

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)

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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)

Extended writing

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

Extended writing

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
6. Heat under reflux ensures complete oxidation

Extended writing

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 1

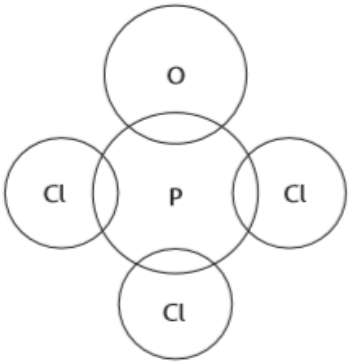
What are the essential points to include when answering the following two questions?

(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)

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Activity 1

(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 2

What is the answer to the following question?

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

Activity 2

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.

Session 2

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)

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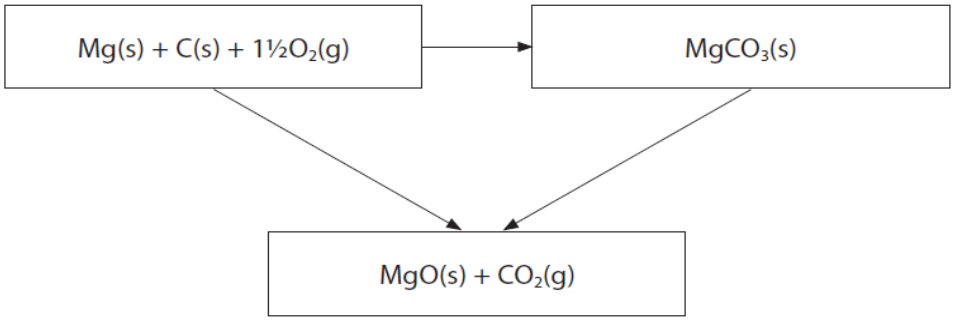
Typical AO2a questions

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)

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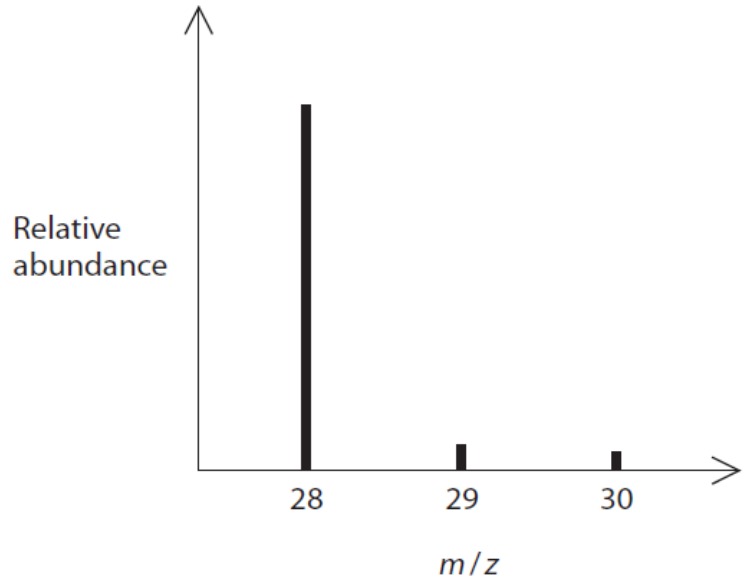
Typical AO2b questions

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

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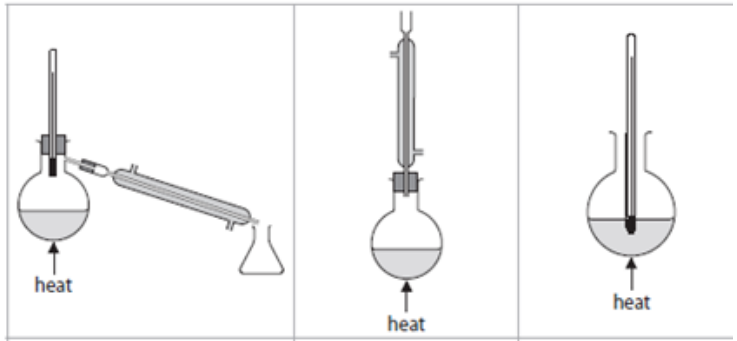
Typical AO3 questions

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)

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Command words

- Questions in our exam papers are designed to use a specific command word to guide students.

- The command words represent a range of skills:
  - simple recall (Give..., Name...)
  - using knowledge (Describe...)
  - giving reasons (Explain...)
  - provide more detailed analysis (Evaluate, Justify)
  - show particular skills (Calculate..., Plot...)

- Is there a link between command words and AOs?

Mark schemes and exemplar student work

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.

AO2 in exams

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?

Break time

Please be back in 5 minutes.

A03 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.

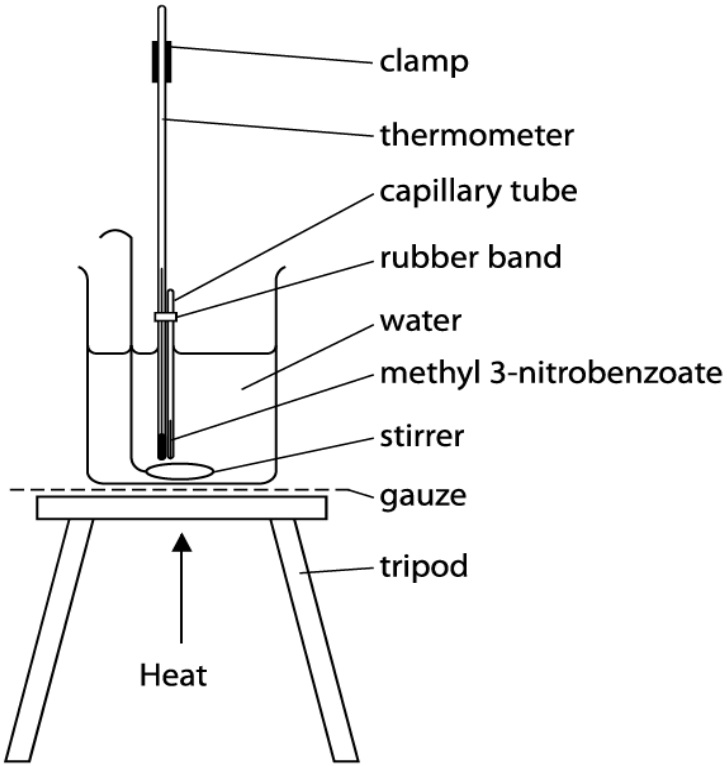
AO3 may also involve the use of experimental data, and the evaluation of experimental methods or results.

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)



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AO3: Recall of practical technique

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** .....

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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)

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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.

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 $E^{\ominus}_{cell}$ 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 $E^{\ominus}_{cell}$ 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

validity

uncertainty

precision

anomaly

accuracy

error

reliability

Accuracy versus precision

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

- If repeated measurements gives 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.

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 overview

Past exam papers and mark schemes

Examiner reports

SAMS

Exemplars and commentaries

Subject Advisor

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Past exam papers and mark schemes

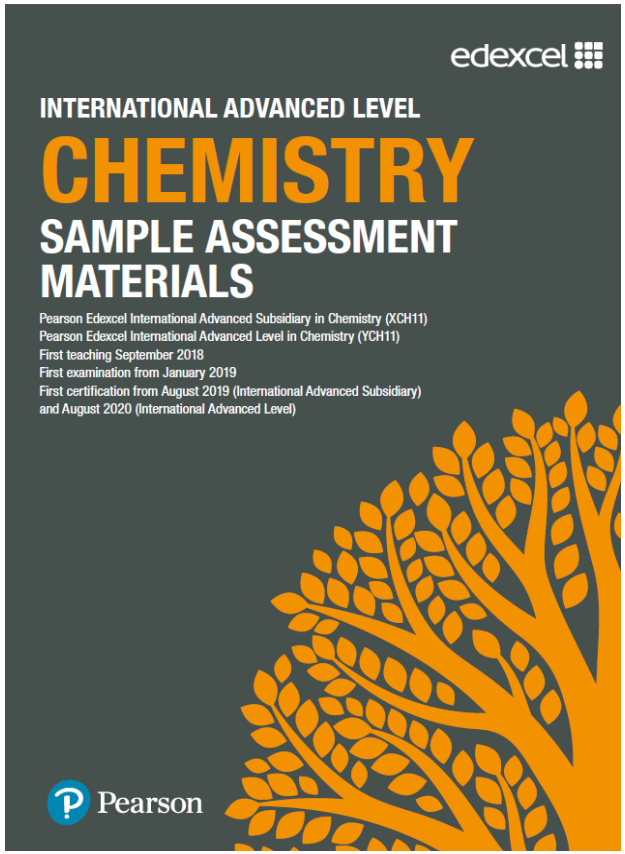
These are available on the Pearson website for both the 2018 specification and the 2013 specification.

Questions from past papers from the 2013 specification can be used but care must be taken to make sure they are relevant to the current (i.e. 2018) specification.

Some content in the 2013 specification is not in the 2018 specification.

SAMs

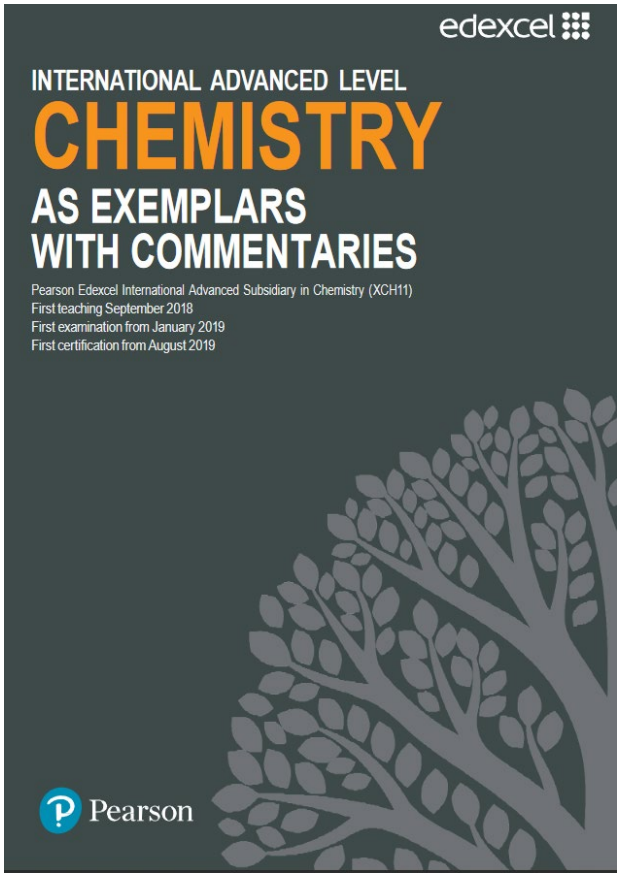
- SAMS is short for Sample Assessment Materials.
- The SAMs are examples of the question papers and mark schemes and show the question types and how they will be marked by the examiners.
- All of our future exam papers are based on these Sample Assessment Materials.



Exemplars and commentaries

Marked exemplars with examiner commentaries

Only available at the moment for IAS



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