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A LEVEL

Assessment story

CHEMISTRY A

H432

For first assessment in 2015

Exploring our question papers
Version 1.0

Version 1.0 (November 2024)

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Contents

Introduction

We have produced this guide to help you prepare your students successfully. In this guide, we share the story of our assessment approach and explore our question papers with you.

Principles for our question papers:

- Keep presentation clear
- Keep the language of our questions simple (assessing understanding of the science rather than comprehension of complex sentences)
- Use clearly defined Command Words.

Specification content

The specification content determines the content that can be assessed. The A Level specification content is made up of six modules:

Module 1 – Development of practical skills in chemistry

1.1 Practical skills assessed in a written examination

1.2 Practical skills assessed in the practical endorsement

Module 2 – Foundations of chemistry

2.1 Atoms and reactions

2.2 Electrons, bonding and structure

Module 3 – Periodic table and energy

3.1 The periodic table

3.2 Physical chemistry

Module 4 – Core organic chemistry

4.1 Basic concepts and hydrocarbons

4.2 Alcohols, haloalkanes and analysis

Module 5 – Physical chemistry and transition elements

5.1 Rates, equilibrium and pH

5.2 Energy

5.3 Transition elements

Module 6 – Organic chemistry and analysis

6.1 Aromatic compounds, carbonyls and acids

6.2 Nitrogen compounds, polymers and synthesis

6.3 Analysis

Modules 1 and 2 cover fundamental skills students require throughout the course.

Modules 3 and 4 are commonly taught during the first year of A Level study.

Modules 5 and 6 are commonly taught during the second year of A Level study.

All the assessments are taken at the end of the course of study so teaching order can be flexible.

Navigating the specification content

The specification is your first port of call for finding out what needs to be taught. The examples below summarise the information available within the main content area of the specification:

The specification aims to help your planning by giving examples of where things such as maths, practical work and 'How Science Works' could be integrated into your teaching. These are examples only; you may prefer to choose other points in the content.

The **Learning outcome** column tells you what needs to be covered in your teaching.

The **Additional guidance** column clarifies what can be tested and includes reference links to other areas of the specification and the skills in the specification appendices.

4.2.4 Analytical techniques

	Learning outcomes	Additional guidance
	Learners should be able to demonstrate and apply their knowledge and understanding of:	
	Mass spectrometry	
(f)	use of a mass spectrum of an organic compound to identify the molecular ion peak and hence to determine molecular mass	*M3.1* Limited to ions with single charges. Learners will **not** be expected to interpret mass spectra of organic halogen compounds. Limited to organic compounds encountered in this specification **(see also 6.3.2 e)**. Learners should be aware that mass spectra may contain a small M+1 peak from the small proportion of carbon-13. HSW3,5 Analysis and interpretation of spectra.

We flag where it is helpful to be aware of related content elsewhere in the specification.

HSW references highlight opportunities to integrate the 'How Science Works' principles to develop wider science skills of benefit to students.

See Appendix 5e in the specification for more details.

3.2.1 Enthalpy changes

	Learning outcomes	Additional guidance
	Learners should be able to demonstrate and apply their knowledge and understanding of:	
	Enthalpy changes: ΔH of reaction, formation, combustion and neutralisation	
(e)	determination of enthalpy changes directly from appropriate experimental results, including use of the relationship: $q = mc\Delta T$	*M0.0, M0.2, M2.2, M2.3, M2.4* **PAG3**

PAG references highlight opportunities for practical activities for students to use the apparatus and techniques required by the practical endorsement.

See Appendix 5h for further details.

Maths references identify the mathematical skills required as part of the topic.

See Appendix 5f in the specification for more details.

Assessment overview

A Level Chemistry A consists of three examined components and the Practical Endorsement component (see Appendix 5g in the specification).

Students must sit all three examined papers and complete the Practical Endorsement.

The qualification is marked out of a **total of 270 marks**. The performance of candidates on the examined papers determines their overall grade. An A Level qualification is awarded on the scale: A*, A, B, C, D, E, where A* is the highest grade. The result for the Practical Endorsement assessment is reported separately.

The modules assessed in the component, marks, duration, and weightings for all components are shown below:

Components	Modules	Marks	Duration	Weighting
Paper 1: Periodic table, elements and physical chemistry	1, 2, 3, 5	100	2 hours 15 minutes	37%
Paper 2: Synthesis and analytical techniques	1, 2, 4, 6	100	2 hours 15 minutes	37%
Paper 3: Unified chemistry	All	70	1 hour 30 minutes	26%
Practical Endorsement Non-exam assessment	1	Assessed internally through a minimum of 12 practical activities		Reported separately

Overview of content in our exams

All of the examined papers assess candidates' knowledge of practical skills (module 1) and foundational chemistry skills (module 2).

In our Chemistry A specification we have split the content assessed in the first two papers. This reduces the cognitive load for candidates early in the assessment series. It also expands the breadth of content that can be assessed, helping to fairly reward candidates for their knowledge of the specification.

The final paper assesses all of the content so candidates can demonstrate their knowledge of the whole specification and the synoptic nature of Chemistry.

Paper 1: Periodic table, elements and physical chemistry
This paper focuses on assessing content from Module 2, Foundations in chemistry, Module 3, Periodic table and energy, and Module 5, Physical chemistry and transition elements.

Paper 2: Synthesis and analytical techniques
This paper focuses on assessing Module 2, Foundations in chemistry, Module 4, Core organic chemistry, and Module 6, Organic chemistry and analysis.

Paper 3: Unified chemistry
This paper assesses content from across all teaching modules.

Assessment objectives

Every question must test one or more of the assessment objectives. Assessment objectives and their approximate weightings for science qualifications are defined by Ofqual.

	Assessment objective elements	% Qualification weighting
AO1	**Demonstrate knowledge and understanding of:** • Scientific ideas and processes • Scientific techniques and procedures.	**31–34**
AO2	**Apply knowledge and understanding of scientific ideas, processes, techniques and procedures:** • in a theoretical context • in a practical context • when handling qualitative data • when handling quantitative data.	**40–43**
AO3	**Analyse, interpret and evaluate scientific information, ideas and evidence to:** • make judgements and reach conclusions • develop and refine practical design and procedures.	**25–28**

Assessment objectives for each question paper

The approximate weighting for each assessment objective for each paper is shown below.

Paper	Approx. % weighting of paper		
	AO1	AO2	AO3
1	34–38	40–44	22–24
2	34–38	40–44	22–24
3	19–23	40–46	34–39

Paper 3 has a greater emphasis on analysing, interpreting and evaluating (AO3) and less emphasis on knowledge and understanding (AO1).

Ofqual has set a maximum limit of 10% of the qualification for marks that can be used to test *knowledge in isolation* as part of AO1.

Knowledge in isolation:

- is awarded solely for recalling facts or other knowledge that is part of the specification.
- is **not** awarded for selecting appropriate knowledge (for example, to evidence an argument), or for applying knowledge to a particular context.

Practical skills

It is an Ofqual requirement that an overall **minimum of 15%** of the marks in our science question papers involve assessment of practical skills.

Practical skills are assessed throughout the three written papers and the Practical Endorsement*.

The table below summarises the practical skills assessed within papers.

Practical skills assessed within papers
Planning
Designing experiments Identifying variables Evaluating that method meets expected outcomes
Implementing
Using apparatus and techniques Measuring with appropriate units Recording results in an appropriate format
Analysis
Processing, analysing and interpreting results Analysing quantitative data using mathematical skills Using appropriate significant figures Plotting and interpreting graphs from experimental results: • selecting and labeling axes, scales, quantities and units • measurement of gradients and intercepts
Evaluation
Evaluating results and drawing conclusions Identifying anomalies in measurements Identifying limitations in procedures Assessing precision and accuracy, including uncertainties and percentage error Refining experimental design to improve procedure and apparatus

Further details are shown in Module 1.1 of the specification.

*** Practical Endorsement**

The experiments and skills required for the Practical Endorsement will allow learners to develop and practise their practical skills, preparing learners for the written examinations.

Papers 1 to 3 will all test candidates' understanding of practical skills and the use of apparatus and techniques from the specification in a wide range of practical contexts. The contexts are not limited to OCR's suggested practical activities.

The Practical Skills Handbook has a lot of useful guidance on practical skills for teachers and students.

Mathematical requirements

Across all papers, at least 20% of the marks assess mathematical skills in the context of chemistry

This includes:

- application and understanding, requiring choice of data or of equation to be used.
- problem solving involving skills from different areas of maths.
- questions involving use of A Level mathematical content, e.g. use of logarithmic equations.

Mathematical skills will always be tested in a chemistry context, and questions testing mathematical skills can test any of the three assessment objectives, AO1 to AO3. A question testing mathematical skills could also be testing, for instance, understanding of practical skills.

The subject content section of the specification indicates where there are opportunities to incorporate the maths skills requirements into teaching and where there are content specific mathematical learning outcomes.

The key mathematical requirements (with examples of skills) are shown below. Further details are shown in Appendix 5e of the Chemistry A specification Maths skills handbook.

- M0 – Arithmetic and numerical computation
- M1 – Handling data
- M2 – Algebra
- M3 – Graphs
- M4 – Geometry and trigonometry

Synoptic assessment

Synoptic assessment involves the drawing together of knowledge, understanding and skills learned in different parts of the A Level course. All papers within Chemistry A will have questions containing an element of synoptic assessment.

A synoptic question will require candidates to construct their answer, using knowledge, skills and understanding from several parts of the specification, for example, by:

- applying knowledge and understanding of more than one area to a particular situation or context
- using knowledge and understanding of principles and concepts in planning experimental and investigative work and in the analysis and evaluation of data
- bringing together, and applying, scientific knowledge and understanding from different areas of the subject.

Level of difficulty

Our aim is to ensure that all students can access all question papers.

We estimate the level of difficulty of each mark as being low (L), medium (M) or high (H) demand. There are approximately equal amounts of each demand type (L, M and H). About one-third of the high demand questions are classified as being 'stretch and challenge', that is targeting A* grade standard.

Our question papers

Candidates are required to respond to a variety of question types in the examined papers.

Paper 1 and Paper 2 – 100 marks each paper

Both papers have a similar format and are divided into two sections, A and B. Candidates answer all questions.

Section A: Multiple choice questions (MCQs) 15 marks

There are 15 MCQs, 1 mark each. MCQs allow assessment of a wide range of content, whilst keeping the overall assessments as short as possible. MCQs are in a separate section of the paper. Research shows that candidates find MCQs more accessible when they are grouped together in this way.

We recommend that candidates spend no more than 20 minutes on Section A. Only AO1 and AO2 are tested in MCQs

Section B: (assesses Assessment Objectives 1, 2 and 3)

Short answer response questions –these consist of structured questions featuring problem-solving, calculations, and practical skills. These types of question are marked by a points-based mark scheme.

Extended response questions – there may be a small number of longer response questions (4–6 marks). These questions are marked using a points-based mark scheme.

Two 6- or 9 -mark questions
These questions are flagged with an asterisk (*) in the paper. These questions are marked by a levels-based mark scheme, and they are usually referred to as 'Level of response questions'. The questions test the ability of the candidate to construct and develop a sustained line of reasoning which is coherent, relevant, substantiated and logically structured.

Paper 3 – 70 marks

Candidates should answer all questions. Candidates will be assessed across all modules of the specification by a combination of question types. There are no multiple-choice questions in paper 3.

The question types are:

Short answer response questions
Marked by a points-based mark scheme; up to 58 marks.

Extended response questions

Two 6-mark level of response (LoR) questions
Flagged with an asterisk, *, in the question paper.

Command words

The most frequently used command words used in our examination papers are listed below. **It is not an exhaustive list.** The definitions provide guidance to teachers and students about what is expected when these words are used in exams.

Command word	Meaning …
Calculate	Work out the numerical value. Show your working when asked to.
Compare	Give an account of the similarities and/or differences between two (or more) items or situations, referring to both (all) of them throughout.
Complete	Add words, numbers, labels or plots to complete a sentence, table, diagram graph, or equation.
Define	Use your knowledge to state the meaning of a given term.
Describe	Give an account using relevant concepts, processes, characteristics and, if necessary, examples.
Draw	Produce a diagram/drawing/graph with sufficient detail/annotation and labels to illustrate the answer.
Estimate	Assign an approximate value.
Evaluate	Make qualitative, or quantitative, judgements and/or reasoning conclusions.
Explain	Use relevant knowledge and/or evidence and/or ideas to demonstrate understanding of why something is the case or how something happens.
Name	Provide appropriate word(s) or term(s).
Plot	Mark points accurately for a given range of values, using labelled axes.
Predict	Make logical connections between other pieces of information to arrive at an answer.
Show that	Write down sufficient details, structured steps or calculations to prove a fact or answer.
Sketch	Produce a simple, freehand drawing to illustrate the general point(s) being conveyed, using annotations as required.
State	Express clearly and briefly.
Suggest	There is often no single correct answer. Candidates will be given credit for sensible reasoning based on correct chemistry.

Accessibility principles

We believe that candidates should be fairly rewarded for what they know and can do. Our aim is to ensure that no student is disadvantaged by not being able to access questions or tasks in an assessment.

We've developed accessibility principles that we use to write our assessment materials and develop new qualifications. We continually review our principles to ensure they meet the latest research and feedback.

Look and feel of the paper

Students can engage quickly and accurately with our assessment materials.

To ensure our assessment material is easy to read we:

- avoid visual overloading by providing adequate white space
- write questions in plain English and avoid jargon and complicated language
- left-align text, diagrams and tables to align with our modified papers to help with a range of visual impairments.

Assessment approach

Students are assessed by a consistent and research proven approach to assessment.

To ensure our materials are as accessible as possible we:

- use command words clearly and consistently
- use short sentences, often bulleted or numbered for ease of reference
- use emboldening for key words or instructions
- avoid the use of confusing contexts in questions
- minimise the use of names or gendered pronouns.

Scientific conventions

Students are supported by presenting scientific information based on accepted conventions, consistent with our specifications.

To ensure students can confidently interpret scientific terminology we:

- present units in a consistent, conventional form, without use of a solidus, e.g. $m\ s^{-1}$
- separate units from the name of the physical quantity in tables and graphs with a solidus, e.g. time / s
- use alternative formatting (e.g. italics for physical quantities) only where scientifically justified
- are consistent in our use of the language of measurement
- use accepted conventions for symbols for circuit diagrams
- provide a data sheet containing the periodic table, spectral data, and selected constants and relationships so the exam assesses the application of chemistry, rather than the recall of facts and relationships.

Question type examples and comments

Multiple choice questions (MCQs)

In papers 1 and 2, Section A comprises 15 multiple choice questions.

- All questions will contain four answer options, **A**, **B**, **C** and **D**.
- Questions require candidates to select a single option.
- A small number of questions contain three statements. Candidates select the option (A, B, C, or D) which identifies the correct statement.
- All options assess specification knowledge/skills/understanding or cover understanding from a previous key stage. Some answer options will include common misconceptions/errors.
- Options are in alphabetical/numerical order (unless there is a scientific justification for presenting in an alternative manner, such as atomic number).
- MCQs do not test AO3.
- There is a box at the end of the options for candidates to indicate their answer.

All examples have been chosen from the past exam papers, available from Teach Cambridge

Example 1

Phosphoric acid is a tribasic acid.

What is the mass of $Ca(OH)_2$ that completely neutralises $100\,cm^3$ of $0.100\,mol\,dm^{-3}$ phosphoric acid?

A 0.49 g

B 0.74 g

C 1.11 g

D 2.22 g

Your answer ☐

The correct answer is **C**.

This questions tests AO2 and maths skills and is a high demand question.

The four values are in increasing numerical order.

The incorrect answers (referred to as **distractors**) demonstrate common errors and/or misconceptions.

[1]

Example 2

Which statement(s) is/are correct when a catalyst is added to a system in dynamic equilibrium?

1 The rates of the forward and reverse reactions increase by the same amount.

2 The concentrations of the reactants and products do not change.

3 The value of K_c increases.

A 1, 2 and 3

B Only 1 and 2

C Only 2 and 3

D Only 1

Your answer ☐ **[1]**

The correct answer (key) is **B**.

This question tests AO1 and is a low demand question.

The incorrect answers (**distractors**) demonstrate common misconceptions.

Short answer questions

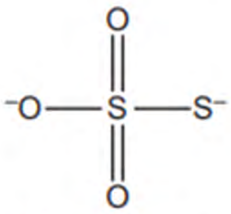
These question types can assess any Assessment objective (AO1, AO2 and AO3) and will include:

- 1, 2 or 3 mark free-response questions
- 1, 2 or 3 mark calculations.

We use short answer questions because they allow broad coverage of the specification, while keeping the length of the examination manageable.

Example

(c) Sodium thiosulfate contains the thiosulfate ion, $S_2O_3^{2-}$.
The displayed formula of $S_2O_3^{2-}$ can be shown as below.



thiosulfate ion

Figures and diagrams in our papers are left-aligned to ensure they are easy to understand. We always aim to have relevant images and diagrams on the same page (or a facing page) as the question.

(i) Predict the O–S–S bond angle and name of the shape of the thiosulfate ion.

Bond angle .....

Name of shape .....

[1]

(ii) In some of its reactions, the thiosulfate ion forms the tetrathionate ion, $S_4O_6^{2-}$.

The $S_4O_6^{2-}$ ion is a 'dimer' of $S_2O_3^{2-}$.

Draw a displayed formula for the $S_4O_6^{2-}$ ion.

These short answer questions illustrate how the demand of these style of questions can vary. The first part assesses AO1 and candidates' knowledge of bond angles and molecular shapes. This is a low demand question.

The second part assesses AO3, requiring candidates to analyse, interpret and evaluate the scientific information provided in the question to arrive at an answer. This is a high demand question, intended to stretch and challenge the highest attaining candidates.

[1]

Longer answer / extended response questions

We class long answer/extended response questions in science as anything over 3 marks. We use these questions to assess across all three Assessment Objectives (AO1, 2 and 3). Questions are marked using a points-based mark scheme.

These question types often include:

- open-ended questions
- synoptic questions linking concepts from across the specification
- data interpretation questions
- questions on experimental design
- questions assessing the application of knowledge in novel contexts
- multi-step calculations.

Where there is a calculation, we will always leave space for candidates to show their working.

The examiner guidance for marking of calculation questions is that if the answer on the answer line is correct, full marks are generally awarded (unless a specific method is required by the question).

It is good practice to show working. Candidates who show their working may be less likely to make a mistake,and may easily spot and correct a mistake themselves. Marks can be given for correct working, even when the final value is incorrect. Where marks are available for this, it is indicated in the mark scheme using 'ECF' (error carried forward).

(b) The standard enthalpy change of reaction, $\Delta_r H^\ominus$, and the standard free energy change, $\Delta G^\ominus$, for converting anhydrous sodium thiosulfate to hydrated sodium thiosulfate are shown below.

$$Na_2S_2O_3(s) + 5H_2O(l) \rightarrow Na_2S_2O_3 \cdot 5H_2O(s)$$

$\Delta_r H^\ominus = -55.8\,kJ\,mol^{-1}$
$\Delta G^\ominus = -16.1\,kJ\,mol^{-1}$

Standard entropies are given in the table.

Compound	$S^\ominus / J\,K^{-1}\,mol^{-1}$
$Na_2S_2O_3 \cdot 5H_2O(s)$	372.4
$H_2O(l)$	69.9

Determine the **standard** entropy, $S^\ominus$, of anhydrous sodium thiosulfate, $Na_2S_2O_3(s)$.

Give your answer to **3** significant figures.

To comply with our accessibility principles there is a clear indication that the answer must be given to 3 significant figures.

This question tests AO2 and is medium demand.

Sometimes questions will ask for answers to be given 'to an appropriate number of significant figures', instead of stating a specific number as is shown here. The appropriate number of significant figures is the lowest number of significant figures in the data used for a calculation.

The unit is given in the answer line for calculation questions, unless providing it is a required part of the question.

$S^\ominus$ = ... $J\,K^{-1}\,mol^{-1}$ **[4]**

Level of Response (LoR) questions

We use the term *Level of Response* (often abbreviated to LoR by teachers and examiners) to cover a specific extended response question that tests a candidate's ability to form and develop a sustained line of reasoning which is coherent, relevant, substantiated and logically presented. An LoR question tests both the substance and organisation of the response and is marked using a level of response mark scheme.

In a question paper, LoR questions are flagged with an asterisk* so the candidate is made clear about how the question is being assessed. There are 6 marks for each LoR question. An LoR question can assess any of the assessment objectives (AO1, AO2 and AO3) and can be on:

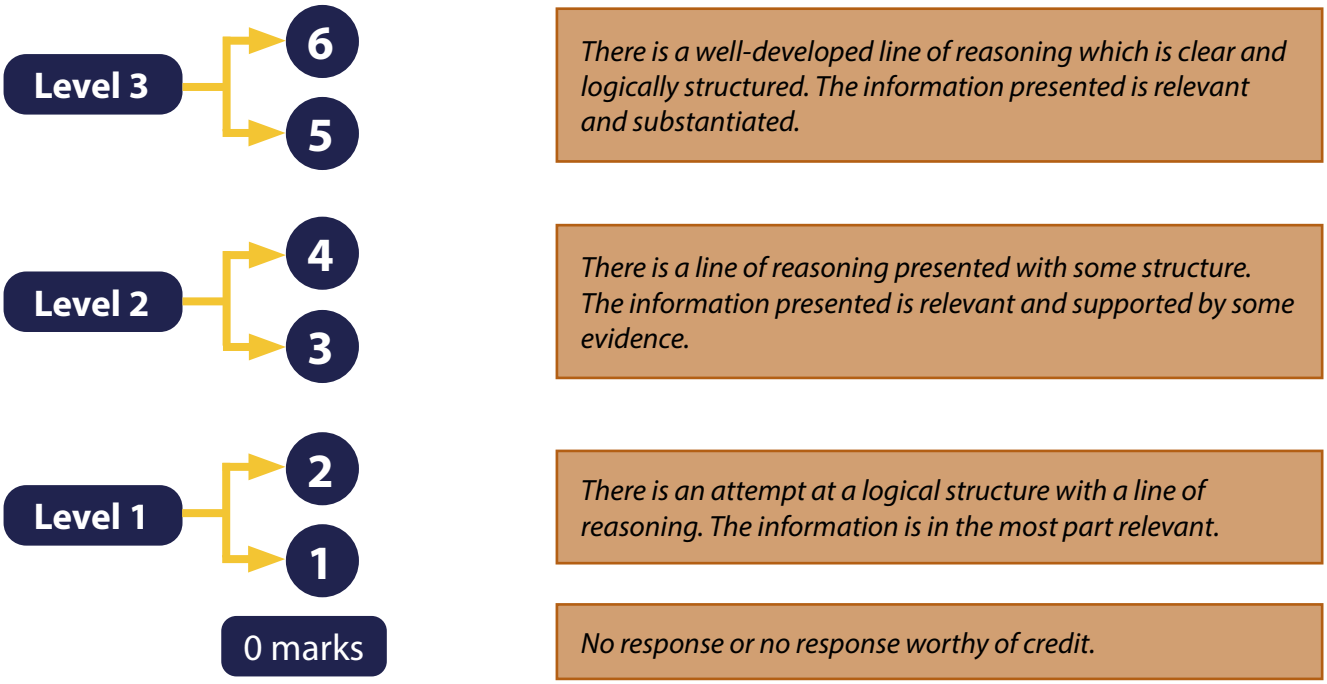
- synopticity
- practical skills
- analysis and evaluation skills
- mathematical skills.

Marking approach for Level of Response questions

Level of response questions are always marked in the same basic way, with the six marks split into three bands: Level 3 (5–6 marks), Level 2 (3–4 marks) and Level 1 (1–2 marks).he communication statements for each level are generic and italicised in the mark scheme.

First, indicative scientific content decides which level an answer is in, based on the level descriptors in the mark scheme.

The higher mark in the level is awarded when all aspects of the communication statement (in italics) are met.



In summary:

- The skills and science content determine the level.
- The communication statement determines the mark within a level.

Example

The asterisk* indicates this question is assessed through level of response (LoR).

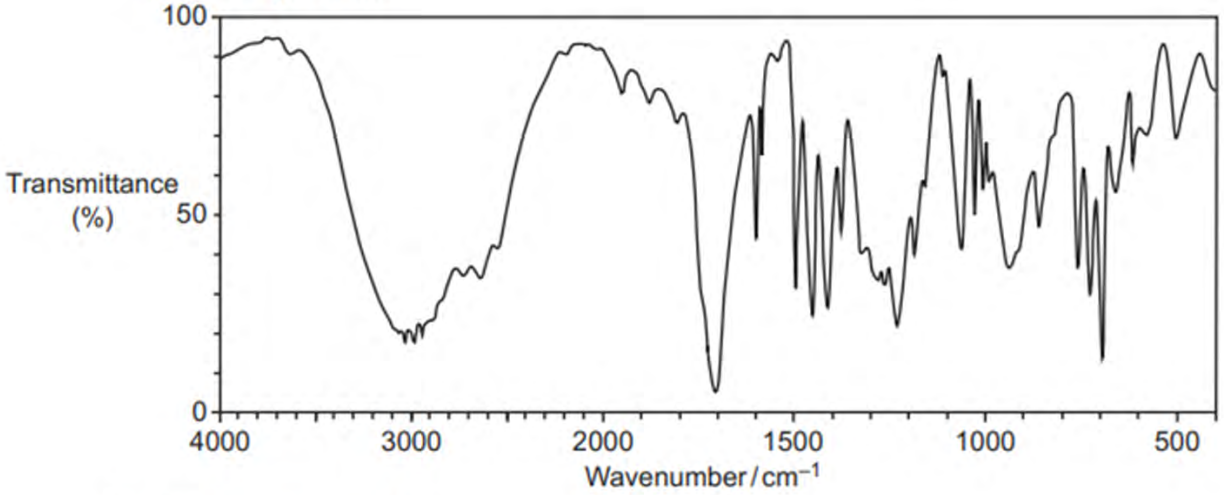
21* Analysis of an unknown organic compound produced the following results.

Elemental analysis by mass
C: 73.17%; H: 7.32%; O: 19.51%

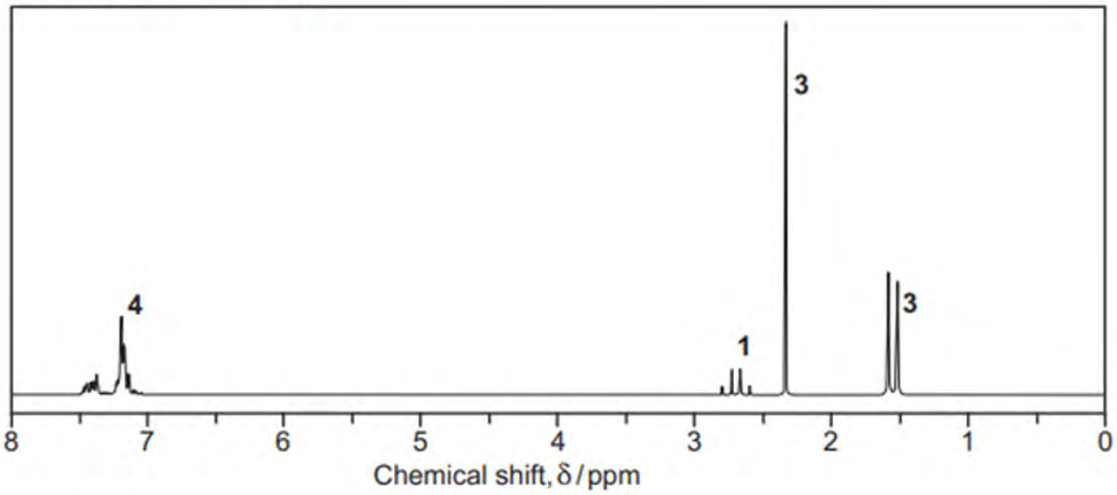
Mass spectrum
Molecular ion peak at $m/z = 164.0$

Useful data for interpretation of spectra is provided on the data sheet which candidates can use in the exam

Infrared spectrum



^{1}H NMR spectrum in D_2O



The numbers by the peaks are the relative peak areas.

Use the results to suggest **one** possible structure for the unknown compound.

Show **all** your reasoning. **[6]**

This question assesses AO1 and AO3, and is a mix of low, medium and high demand. It's common for questions marked with a level of response mark scheme to assess multiple assessment objectives and cover a range of demand, so that all candidates can attempt the question.

Candidate Exemplar

A Level Chemistry A — Exemplar Candidate Work

C: 73·17 / 12 = 6·0975 / 1·219375 = 5

H: 7·32 / 1 = 7·32 / 1·219375 = 6

O: 19·51 / 16 = 1·219375 / 1·219375 = 1

Empirical = C_5H_6O The molecular mass is 164 so the molecular formula is $C_{10}H_{12}O_2$

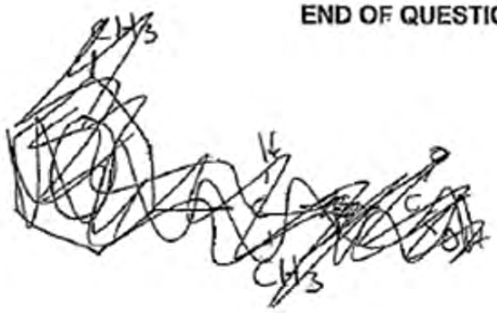
The sharp peak at 1700 cm^{-1} is due to a C=O group. The broad peak at 3000 cm^{-1} is due to a O-H. This suggests a carboxylic acid is present.

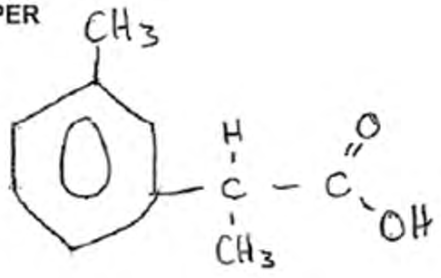
Additional answer space if required

Peak at 1·5 ppm is due to a CH_3 group. It is a doublet due to being adjacent to 1 proton. Peak at 2·4 ppm is due to a CH_3 group. It is a singlet due to being adjacent to 0 protons. Peak at 7·2 ppm is due to a benzene ring. The peak at 2·7 ppm is due to a $HC-\overset{O}{\overset{\|}{C}}$ group. It is a quartet due to being adjacent to 3 protons.

This response would have scored full marks

END OF QUESTION PAPER

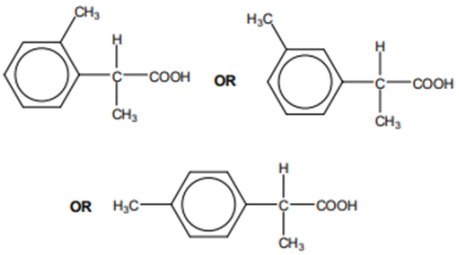




1 1

Marking descriptors for each level of response.

These are 'indicative points' for the examiners.

21*	*Please refer to the marking instructions on page 4 of this mark scheme for guidance on how to mark this question.* **Level 3 (5–6 marks)** Structure is $CH_3C_6H_4CH(CH_3)COOH$ **AND** Most of the data analysed. *There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.* **Level 2 (3–4 marks)** A viable aromatic structure of $C_{10}H_{12}O_2$ that contains C=O **AND** most key features consistent with spectral data **AND** Some of the spectral data analysed *There is a line of reasoning presented with some structure. The information presented is relevant and supported by some evidence.* **Level 1 (1–2 marks)** Correct determination of empirical formula and/or molecular formula. **OR** Analyses some of the IR and NMR data. **OR** Analyses most of the NMR data. *There is an attempt at a logical structure with a line of reasoning. The information is in the most part relevant.* **0 marks** No response or no response worthy of credit.	6	AO1.2 × 2 AO3.1 × 2 AO3.2 × 2	**Indicative scientific points:** **Empirical and Molecular Formulae** • C : H : O = $\frac{73.17}{12.0} : \frac{7.32}{1.0} : \frac{19.51}{16.0}$ = 6.10 : 7.32 : 1.22 = 5 : 6 : 1 • Empirical formula = C_5H_6O • uses *m/z* = 164.0 to determine molecular formula as $C_{10}H_{12}O_2$ **Structure** **ALLOW** any combination of skeletal **OR** structural **OR** displayed formula as long as unambiguous **Key features of an aromatic structure consistent with spectral data** • COOH group • 4 aromatic H atoms • single H atom that would give a quartet • CH_3 group that would give a doublet • CH_3 group that would give a singlet **Correct Structure** • $CH_3C_6H_4CH(CH_3)COOH$ **ALLOW** 2-, 3- **OR** 4- substitution of ring *i.e.*  **Spectral analysis** **^{1}H NMR** • δ = 1.6 ppm, doublet, 3H **CH_3**–CH– • δ = 2.3 ppm, singlet, 3H Ar-**CH_3** • δ = 2.7 ppm, quartet, 1H CO–**CH**–CH_3 **OR** Ar–**CH**–CH_3 / C_6H_5–**CH**–CH_3 • δ = 7.1–7.5 ppm, multiplet, 4H **C_6H_4**– **ALLOW** approximate values for chemical shifts. **IR:** • peak at 2300–3700 (cm^{-1}) is O–H • peak at ~1720 (cm^{-1}) is C=O • unknown is a carboxylic acid **ALLOW** ranges from *Data Sheet* **IGNORE** references to C–O peaks
	Total	**6**			

Communication statements

We can see from the mark scheme above that Level 3 descriptor for 5–6 marks requires candidates to provide the correct structure and analysis of **most** of the data. All the indicative points do not have to be met to gain Level 3. The higher mark in the level is awarded if the communication statement in italics is met.

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