

GCE

Chemistry A

H032/02: Depth in chemistry

AS Level

Mark Scheme for June 2025

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It is also responsible for developing new specifications to meet national requirements and the needs of students and teachers. OCR is a not-for-profit organisation; any surplus made is invested back into the establishment to help towards the development of qualifications and support, which keep pace with the changing needs of today's society.

This mark scheme is published as an aid to teachers and students, to indicate the requirements of the examination. It shows the basis on which marks were awarded by examiners. It does not indicate the details of the discussions which took place at an examiners' meeting before marking commenced.

All examiners are instructed that alternative correct answers and unexpected approaches in candidates' scripts must be given marks that fairly reflect the relevant knowledge and skills demonstrated.

Mark schemes should be read in conjunction with the published question papers and the report on the examination.

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MARKING INSTRUCTIONS

PREPARATION FOR MARKING RM ASSESSOR

1. Make sure that you have accessed and completed the relevant training packages for on-screen marking: *RM Assessor Online Training: OCR Essential Guide to Marking*.
2. Make sure that you have read and understood the mark scheme and the question paper for this unit. These are available in RM Assessor
3. Log-in to RM Assessor and mark the **required number** of practice responses (“scripts”) and the **required number** of standardisation responses.

MARKING

1. Mark strictly to the mark scheme.
2. Marks awarded must relate directly to the marking criteria.
3. The schedule of dates is very important. It is essential that you meet the RM Assessor 50% and 100% (traditional 40% Batch 1 and 100% Batch 2) deadlines. If you experience problems, you must contact your Team Leader (Supervisor) without delay.
4. If you are in any doubt about applying the mark scheme, consult your Team Leader by telephone or the RM Assessor messaging system, or by email.
5. **Crossed Out Responses**
Where a candidate has crossed out a response and provided a clear alternative then the crossed out response is not marked. Where no alternative response has been provided, examiners may give candidates the benefit of the doubt and mark the crossed out response where legible.

Rubric Error Responses – Optional Questions

Where candidates have a choice of question across a whole paper or a whole section and have provided more answers than required, then all responses are marked and the highest mark allowable within the rubric is given. Enter a mark for each question answered into RM assessor, which will select the highest mark from those awarded. (*The underlying assumption is that the candidate has penalised themselves by attempting more questions than necessary in the time allowed.*)

Multiple Choice Question Responses

When a multiple choice question has only a single, correct response and a candidate provides two responses (even if one of these responses is correct), then no mark should be awarded (as it is not possible to determine which was the first response selected by the candidate).

When a question requires candidates to select more than one option/multiple options, then local marking arrangements need to ensure consistency of approach.

Contradictory Responses

When a candidate provides contradictory responses, then no mark should be awarded, even if one of the answers is correct.

Short Answer Questions (requiring only a list by way of a response, usually worth only **one mark per response**)

Where candidates are required to provide a set number of short answer responses then only the set number of responses should be marked. The response space should be marked from left to right on each line and then line by line until the required number of responses have been considered. The remaining responses should not then be marked. Examiners will have to apply judgement as to whether a 'second response' on a line is a development of the 'first response', rather than a separate, discrete response. *(The underlying assumption is that the candidate is attempting to hedge their bets and therefore getting undue benefit rather than engaging with the question and giving the most relevant/correct responses.)*

Short Answer Questions (requiring a more developed response, worth **two or more marks**)

If the candidates are required to provide a description of, say, three items or factors and four items or factors are provided, then mark on a similar basis – that is downwards (as it is unlikely in this situation that a candidate will provide more than one response in each section of the response space.)

Longer Answer Questions (requiring a developed response)

Where candidates have provided two (or more) responses to a medium or high tariff question which only required a single (developed) response and not crossed out the first response, then only the first response should be marked. Examiners will need to apply professional judgement as to whether the second (or a subsequent) response is a 'new start' or simply a poorly expressed continuation of the first response.

6. Always check the pages (and additional objects if present) at the end of the response in case any answers have been continued there. If the candidate has continued an answer there, then add the annotation 'SEEN' to confirm that the work has been seen and mark any responses using the annotations in section 11.
7. There is a NR (**No Response**) option. Award NR (No Response):
- if there is nothing written at all in the answer space
 - OR if there is a comment which does not in any way relate to the question (e.g., 'can't do', 'don't know')
 - OR if there is a mark (e.g., a dash, a question mark) which is not an attempt at the question.
- Note: Award 0 marks – for an attempt that earns no credit (including copying out the question).
8. The RM Assessor **comments box** is used by your team leader to explain the marking of the practice responses. Please refer to these comments when checking your practice responses. **Do not use the comments box for any other reason.**
- If you have any questions or comments for your team leader, use the phone, the RM Assessor messaging system, or e-mail.
9. Assistant Examiners will send a brief report on the performance of candidates to their Team Leader (Supervisor) via email by the end of the marking period. The report should contain notes on particular strengths displayed as well as common errors or weaknesses. Constructive criticism of the question paper/mark scheme is also appreciated.

10. For answers marked by **levels of response**:

Read through the whole answer from start to finish, using the Level descriptors to help you decide whether it is a strong or weak answer. The indicative scientific content in the Guidance column indicates the expected parameters for candidates' answers, but be prepared to recognise and credit unexpected approaches where they show relevance. Using a 'best-fit' approach based on the skills and science content evidenced within the answer, first decide which set of level descriptors, Level 1, Level 2 or Level 3, best describes the overall quality of the answer.

Once the level is located, award the higher or lower mark:

The higher mark should be awarded where the level descriptor has been evidenced and all aspects of the communication statement (in italics) have been met.

The lower mark should be awarded where the level descriptor has been evidenced but aspects of the communication statement (in italics) are missing.

In summary:

The skills and science content determines the level.

The communication statement determines the mark within a level.

Level of response questions on this paper are **2(a)(ii)** and **5(c)**.

The only annotation on a level of response question should be the indication of the level.

A level annotation should be used where all marks for a level have been achieved e.g. a candidate has 6 marks, so they would have this annotation on their script:

L3

If a candidate has achieved 5 marks then they have reached Level 3 but with one mark omitted. They should have the following annotations on their scripts:

L3 

The same principle should be applied to Level 2 and Level 1.

No marks (0) should have a cross: 

Place the annotations alongside the mark for the question.

On additional pages, annotate using 

11. Annotations

Annotation	Meaning
	Correct response
	Incorrect response
	Omission mark
	Benefit of doubt given
	Contradiction
	Rounding error
	Error in number of significant figures
	Error carried forward
	Level 1
	Level 2
	Level 3
	Benefit of doubt not given
	Noted but no credit given
	Ignore
	Blank page

12. Subject Specific Marking Instructions

Abbreviations, annotations and conventions used in the detailed Mark Scheme (to include abbreviations and subject-specific conventions).

Annotation	Meaning
/; OR	alternative and acceptable answers for the same marking point
✓	Separates marking points
DO NOT ALLOW	Answers which are not worthy of credit
IGNORE	Statements which are irrelevant
ALLOW	Answers that can be accepted
()	Words which are not essential to gain credit
—	Underlined words must be present in answer to score a mark
ECF	Error carried forward
AW	Alternative wording
ORA	Or reverse argument

INTRODUCTION

Your first task as an Examiner is to become thoroughly familiar with the material on which the examination depends. This material includes:

- the specification, especially the assessment objectives
- the question paper
- the mark scheme.

You should ensure that you have copies of these materials.

You should ensure also that you are familiar with the administrative procedures related to the marking process. These are set out in the OCR booklet **Instructions for Examiners**. If you are examining for the first time, please read carefully **Appendix 5 Introduction to Script Marking: Notes for New Examiners**.

Please ask for help or guidance whenever you need it. Your first point of contact is your Team Leader.

Question			Answer	Mark	Guidance
1	(a)		releases OH ⁻ /hydroxide (ions in aqueous solution) ✓	1	ALLOW containing/forms OH ⁻ (ions) ALLOW ionises to give OH ⁻ (ions) IGNORE mention of pH
1	(b)		H ⁺ + OH ⁻ → H ₂ O ✓	1	IGNORE state symbols
1	(c)	(i)	FIRST CHECK THE ANSWER ON ANSWER LINE IF $\Delta H = -56.1$ (kJ mol⁻¹) award 4 marks IF $\Delta H = (+)56.1$ (kJ mol⁻¹) award 3 marks Energy released in J OR kJ $Q = mc\Delta T = 80 \times 4.18 \times 9.4$ $= 3143.36$ (J) OR 3.14336 (kJ) ✓ Calculates nH₂O/nHCl/nNaOH $\frac{40 \times 1.4}{1000} = 0.056(0)$ (mol) ✓ ΔH per mole H₂O $\frac{3.14336}{0.056} = \pm 56.131428....$ (kJ mol⁻¹) OR $\frac{3143.36}{0.056} = \pm 56,131.428....$ (J mol⁻¹) ✓ ΔH in kJ mol⁻¹ to 3 SF AND – sign $\Delta H = -56.1$ (kJ mol⁻¹) ✓	4	FULL ANNOTATIONS MUST BE USED ----- ALLOW ECF throughout ALLOW 3140 (J) OR 3.14 (kJ) DO NOT ALLOW < 3 SF IGNORE any sign IGNORE units i.e. ALLOW correctly calculated number in J OR kJ OR no units IGNORE trailing zeroes e.g ALLOW 0.056 Sign NOT needed Common Errors -28.1 3 marks Use of 40g instead of 80g or 2 x 0.056 mol -1690 3 marks +273 for temp change Final answer must have 3 SF AND – sign

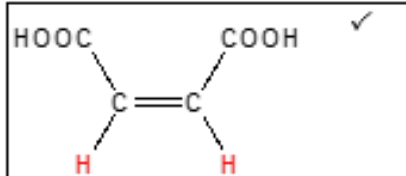
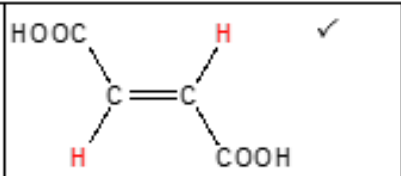
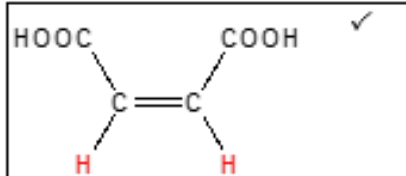
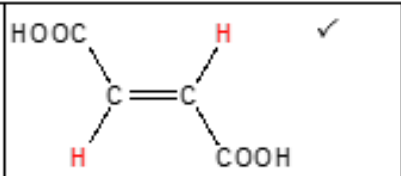
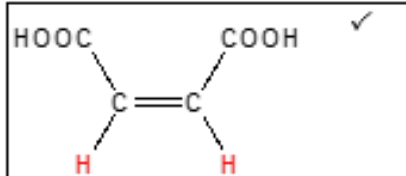
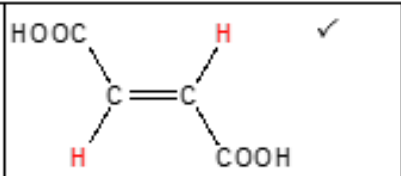
Question			Answer	Mark	Guidance
1	(c)	(ii)	Same number of moles (of HCl / H_2O) ✓ Same q/ energy/heat (released) AND (spread over a) smaller (total) volume / mass ✓	2	IGNORE responses related to changes in rate of reaction ALLOW calculation which shows number of moles is same i.e. $0.02 \times 2.8 = 0.056$ (ALLOW ECF from (i) for this calculation) ALLOW ΔH or Enthalpy change for 'heat' ALLOW calculation to give $\Delta T = 12.5^\circ\text{C}$ (using mass = 60 and same q value) (ALLOW ECF from (i) for this calculation)

Question			Answer	Mark	Guidance
2	(a)	(i)	$\text{Ca}^+(\text{g}) \rightarrow \text{Ca}^{2+}(\text{g}) + \text{e}^-$	1	ALLOW $\text{Ca}^+(\text{g}) - \text{e}^- \rightarrow \text{Ca}^{2+}(\text{g})$ ALLOW e for electron (i.e. charge omitted) IGNORE states on the electron
2	(a)	(ii)	<i>Please refer to the marking instructions on page 5 of the mark scheme for guidance on how to mark this question.</i> Level 3 (5-6 marks) Covers all 3 areas A, B and C in detail with very few omissions or errors <i>There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.</i> Level 2 (3-4 marks) Covers at least 2 areas in detail with very few omissions or errors OR Covers all 3 areas in some detail <i>There is a line of reasoning presented with some structure. The information presented is relevant and supported by some evidence.</i> Level 1 (1-2 marks) Covers 1 area in detail with very few omissions or errors OR Covers 2 areas in some detail <i>There is an attempt at a logical structure with a line of reasoning. The information is in the most part relevant.</i> 0 marks No response or no response worthy of credit	6	Mark additional answer space P5 as SEEN Indicative scientific points may include: A Difference in Reactivity and Explanation ORA is allowed for the following: - Ca more reactive than Mg. - Atomic radius of Ca is greater or more shells/shielding. - Attraction of outer electrons to the nucleus is less. - Ionisation energies of Ca are less. OR Easier to remove Ca outer electrons. B Observations and equation - Effervescence/fizzing/bubbles - Ca/solid disappears/dissolves OR Forms a white ppt/solid $\text{Ca} + 2\text{H}_2\text{O} \rightarrow \text{Ca}(\text{OH})_2 + \text{H}_2$ (IGNORE state symbols) C Redox - Both oxidation and reduction take place. - Ca is oxidised - Oxidation number of Ca increases from 0 to +2 OR Ca loses 2 electrons (to form Ca^{2+} ions) - H is reduced - Oxidation number of H decreases from +1 to 0 OR H gains 1 electron (per H atom) Aspects of the communication statement might typically have been met for all levels when:

Question			Answer	Mark	Guidance
					- All information given is correct using appropriate scientific language, for example (in A) comparison of Mg and Ca not just trend down group and (in C) directly links redox to oxidation and reduction. - There are no errors, for example incorrect balancing, using +2 as initial oxidation state for H.
2	(b)	(i)	FIRST CHECK THE ANSWER ON ANSWER LINE IF vol = 184 cm³ award 2 marks $n(\text{BaCO}_3) = \frac{1.51}{197.3}$ OR $7.6533 \dots \times 10^{-3} \checkmark$ $v\text{CO}_2 = 7.6533 \dots \times 10^{-3} \times 24000 = 184 \text{ cm}^3 \checkmark$	2	ALLOW 3SF up to calculator value $7.653319818 \times 10^{-3}$ IGNORE rounding errors past 3SF ALLOW ECF from incorrect $n(\text{BaCO}_3)$ Answer must be 3 SF and in cm^3 ALLOW use of ideal gas equation with an appropriate temperature (290–298K) and pressure (100/101/101325 kPa) e.g. e.g. At 293K and 100 kPa, $V = (7.65 \dots \times 10^{-3} \times 8.314 \times 293) / 100 \times 10^3$ $V = 186 \text{ cm}^3$
		(ii)	Any two from $\checkmark\checkmark$	2	IGNORE Incomplete reaction IGNORE human errors e.g. unsealed apparatus, gas escaping the measuring cylinder

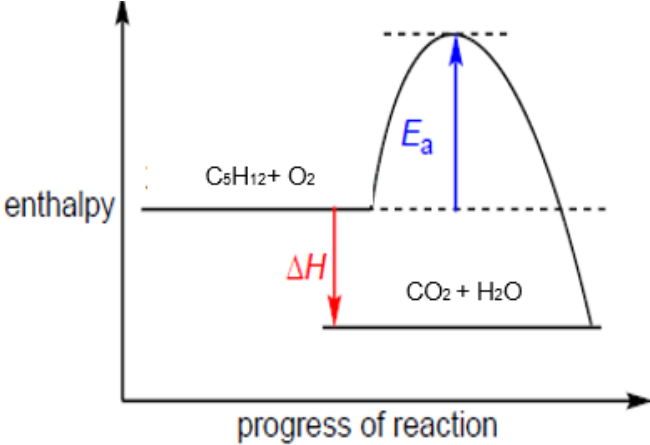
Question			Answer	Mark	Guidance
			• (Gas lost /escapes) when the bung is replaced • Some CO₂ / gas dissolves (in the water) • Conditions / T/ P not at RTP		ALLOW 'when BaCO ₃ is added to flask' ALLOW not standard conditions
		(iii)	Use a gas syringe (in place of the upturned measuring cylinder) OR Place the barium carbonate inside a small tube and release it into the acid without removing the stopper OWTTE ✓	1	IGNORE gas cylinder ALLOW use a water bath set at room temperature

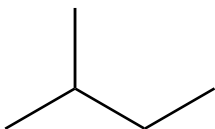
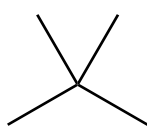
Question			Answer	Mark	Guidance			
3	(a)	(i)	<table border="1"><tr><td>23.30</td><td>23.05</td><td>23.15</td></tr></table> ✓	23.30	23.05	23.15	1	DO NOT ALLOW 23.3
23.30	23.05	23.15						
		(ii)	Mean titre = $\frac{23.05 + 23.15}{2} = 23.1(0)$ ✓	1	ALLOW ECF from incorrect titres from 3a(i) but values must be concordant (i.e. within 0.1 cm ³ of each other)			
		(iii)	FIRST CHECK THE ANSWER ON THE ANSWER LINE If answer = 413 (mg) award 5 marks $n(\text{NaOH}) = \frac{23.1 \times 0.08}{1000} = 1.848 \times 10^{-3} \checkmark$ $n(\text{acid}) \text{ in } 25 \text{ cm}^3 = \frac{1.848 \times 10^{-3}}{2} = 9.24 \times 10^{-4} \checkmark$ $n(\text{acid}) \text{ in } 250 \text{ cm}^3 \text{ for 3 tablets} = 9.24 \times 10^{-4} \times 10$ $= 9.24 \times 10^{-3} \checkmark$ $\text{mass of acid in 3 tablets} = 9.24 \times 10^{-3} \times 134$ $= 1.23(816) \text{ g } \checkmark$ $\text{mass of acid in one tablet} = \frac{1.23816 \times 1000}{3} = 413 \text{ (mg) } \checkmark$ ALLOW ECF from incorrect mean titre in b(ii) and throughout ALLOW 3SF up to calculator value throughout TAKE CARE: values shown may be truncated calculator values. IGNORE rounding errors past 3SF Steps can be calculated in any order which will change the intermediate answers. Marks are for the processing of the data. Alternative Approach $n(\text{acid}) \text{ in one tablet} = 9.24 \times 10^{-4} / 3 = 3.08 \times 10^{-3} \checkmark$ $\text{mass of acid in one tablet} = 3.08 \times 10^{-3} \times 134 \times 1000$$= 413 \text{ (mg) } \checkmark$ Final answer must be to 3 SF AND mg COMMON ERRORS 0.413, 4.13, 41.3 4 marks Incorrect conversion to mg (check for x 10 in method) 1240 / 1238 4 marks Not divided by 3 for 1 tablet	5				

Question			Answer	Mark	Guidance				
3	(b)		The titre would be greater ✓ (NaOH) would be more dilute / less concentrated (so a bigger volume would be needed to neutralise the acid). ✓	2	ALLOW AW				
3	(c)		<table><tr><td></td><td></td></tr><tr><td><i>cis</i></td><td><i>trans</i></td></tr></table>			<i>cis</i>	<i>trans</i>	2	ALLOW any combination of skeletal OR structural OR displayed formula as long as unambiguous ALLOW one mark if both stereoisomers of are shown but in the incorrect columns DO NOT ALLOW incorrect connectivity e.g.  or - HOOC on first occasion but allow ECF in second structure.
									
<i>cis</i>	<i>trans</i>								

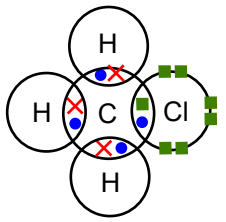
Question			Answer	Mark	Guidance
4	(a)		Trend: Boiling point increases (down the series) AND As chain length increases ✓ Explanation: More (surface) contact / interaction (between molecules) ✓ More /stronger induced dipole(–dipole) interactions/ London (dispersion) forces (between molecules) ✓ More energy to break induced dipole(–dipole) interactions/London forces/intermolecular forces/intermolecular bonds✓	4	ANNOTATE WITH TICKS AND CROSSES Comparisons needed throughout ORA throughout IGNORE references to Enthalpy of Combustion ALLOW the following for ‘chain length increases’ - Longer molecule/alkane - Number of carbons increases (<i>question says they are straight chain alkanes</i>) DO NOT ALLOW reference to presence of branching Surface area alone is not sufficient, must have idea of contact. IGNORE comments about packing ALLOW more electrons (as chain length increases) IGNORE van der Waals’/vdw forces DO NOT ALLOW reference to other intermolecular forces e.g. permanent dipole(–dipole) or hydrogen bonding. ALLOW ‘more energy to break intermolecular forces’ if intermolecular forces are not identified or incorrect. IGNORE harder to overcome/break intermolecular forces (<i>no reference to energy</i>) IGNORE just ‘bonds’ intermolecular/London forces required DO NOT ALLOW Covalent bonds break
4	(b)	(i)	$\text{C}_5\text{H}_{12} + 8\text{O}_2 \rightarrow 5\text{CO}_2 + 6\text{H}_2\text{O}$ ✓	1	IGNORE state symbols DO NOT ALLOW multiples

Question			Answer	Mark	Guidance
4	(b)	(ii)	FIRST CHECK THE ANSWER ON THE ANSWER LINE If answer = 0.063 OR 0.0627(g) award 2 marks Mass CO₂ produced from one mole C₅H₁₂ = 5 x 44.0 OR 220 (g) ✓ Mass of CO₂ produced per 1.00 kJ = $\frac{220}{3509} = 0.0627 \text{ (g) } ✓$	2	ALLOW ECF from incorrect mole ratio in equation (b)(i) calculator value 0.06269592476 IGNORE significant figures, marks can be awarded based on correct method e.g. ALLOW 0.06 for final answer provided working is shown Alternative approaches: The calculation has 3 steps which can be done in any order: • X 5 • X 44 • Divide by 3509 Need 2 steps for first mark, and final step scores second mark. Moles of CO₂ per 1.00 kJ = (1.00/3509) x 5 OR 1.4249... x 10⁻³ ✓ Mass of CO₂ produced per 1.00 kJ = 1.4249... x 10⁻³ x 44 = 0.0627 (g) ✓ OR Mass of CO₂ per mol per 1.00 kJ = 44/3509 OR 0.012539... ✓ Mass of CO₂ produced per 1.00 kJ = 0.012539... x 5 = 0.0627 (g) ✓

Question	Answer	Mark	Guidance
4 (b) (iii)	 Reactants, products and E_a Reactants on LHS $C_5H_{12} + O_2$ AND Products on RHS $CO_2 + H_2O$ AND Activation energy correctly labelled / E_a ✓ ΔH ΔH labelled with product below reactant AND Arrow downwards ✓	2	ANNOTATE ANSWER WITH TICKS AND CROSSES ETC IGNORE state symbols ALLOW 1 mark for a correctly labelled endothermic diagram IGNORE stoichiometry even if incorrect ALLOW ECF from incorrect reactant and products in equation (b)(i) For E_a, ALLOW AE OR A_E ALLOW arrowheads at each end of E_a line OR no arrowhead BUT DO NOT ALLOW arrowhead down E_a line must reach maximum (or near to maximum) on curve DO NOT ALLOW $-\Delta H$ DO NOT ALLOW double headed arrow on ΔH ALLOW ΔH arrow even with small gap at the top and bottom, i.e. line does not quite reach reactant or product line. ALLOW -3509 for ΔH
4 (b) (iv)	$-2900 \text{ (kJ mol}^{-1}\text{)}$ ✓	1	Must be 2 SF with negative sign
4 (c)		2	

Question			Answer	Mark	Guidance
			  (2-)methylbutane (2,2-)dimethylpropane ✓✓		ALL 4 points → 2 marks 2 OR 3 points → 1 mark Structures must be skeletal Numbers in names are not required but if given must be correct IGNORE lack of hyphens, extra hyphens, or addition of commas DO NOT ALLOW the following for methyl: methy, meth, methly
4	(d)	(i)	$\text{C}_3\text{H}_8 + \text{Br}_2 \rightarrow \text{C}_3\text{H}_7\text{Br} + \text{HBr}$ ✓	1	IGNORE state symbols
4	(d)	(ii)	(covalent/Br-Br) bond breaks AND each (bonding) atom / Br receives one electron from the bonding / shared pair ✓	1	ALLOW the breaking of (a covalent/Br-Br) bond where each atom keeps one of the bonding electrons ALLOW when a bond breaks one electron from the bond goes to each product / species / radical DO NOT ALLOW 'molecule' or 'compound' or 'particle' or 'element' for 'atom' IGNORE homolytic fission equations
4	(d)	(iii)	$\text{C}_3\text{H}_8 + \text{Br}\cdot \rightarrow \cdot\text{C}_3\text{H}_7 + \text{HBr}$ ✓ $\cdot\text{C}_3\text{H}_7 + \text{Br}_2 \rightarrow \text{C}_3\text{H}_7\text{Br} + \text{Br}\cdot$ ✓	2	ALLOW dot at any position on the radical ALLOW 1 mark if both equations correct but any dots omitted from radicals
4	(d)	(iv)	Br can substitute at different positions along (carbon) chain	1	ALLOW AW e.g

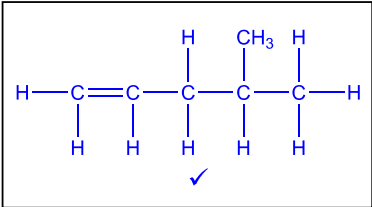
Question			Answer	Mark	Guidance
			OR two different radicals form $\text{CH}_3\text{CH}_2\text{CH}_2$ AND CH_3CHCH_3 ✓		ALLOW Br can replace an end H or a middle H ALLOW Br can substitute at any C IGNORE position of radical dot on radical structures IGNORE references to minor/major product DO NOT ALLOW stability of carbocations/haloalkanes

Question			Answer	Mark	Guidance
5	(a)	(i)	 <i>Check that lone pairs on Cl are included</i> <i>Cl has 6 non-bonded electrons (3 LPs)</i>	1	Circles are NOT required IGNORE inner shells ALLOW non-bonding electrons unpaired Must have three different symbols (one for C, another for H and another for Cl) e.g. ○ = C electron × = H electron ■ = Cl electron
5	(a)	(ii)	Tetrahedral ✓ 109.5° ✓	2	ALLOW 109 to 110°
5	(b)		Bond Angle 120° ✓	3	ALLOW 116- 124° IGNORE names of shapes (even if wrong)

Question			Answer	Mark	Guidance
			Number of bonded regions CH_3Cl has 4 bonded pairs (of electrons) AND $\text{H}_2\text{C}=\text{CHCl}$ has 3 bonded regions ✓ Electron pair repulsion (<i>seen anywhere</i>) Electron pairs/bonded pairs repel (as far apart as possible) ✓ Electron pairs/bonded pairs essential DO NOT ALLOW 'bonded atoms' for this mark		ALLOW bp for bonded/bonding pair (of electrons) Bonded/Bonding is essential ALLOW for CH_3Cl/chloromethane: • 4 bonded areas/environments/regions • 4 bonded groups/atoms ALLOW for $\text{H}_2\text{C}=\text{CHCl}$/chloroethene: • 2 bonded pairs and 1 double bond • 2 bonded pairs and 1 bonded area/environment/region • 3 bonded groups/atoms IGNORE areas of electron density ALLOW alternative phrases/words for 'repel' e.g. 'push apart' DO NOT ALLOW 'atoms repel' IGNORE • electrons repel • bonds repel • electron region OR electron density repel • lone pairs repel (more) (<i>irrelevant here</i>)
5	(c)		<i>Please refer to the marking instructions on page 4 of this mark scheme for guidance on how to mark this question.</i> Level 3 (5–6 marks) Describes ALL purification steps in correct order AND	6	Mark additional answer space P17 as SEEN Indicative scientific points may include: Main purification steps • Use a separating funnel • Add anhydrous salt (to organic layer)

Question	Answer	Mark	Guidance
	Explains MOST purification steps AND Calculates correct mass of $\text{CH}_3\text{CH}_2\text{CHC}/\text{CH}_3$ <i>There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.</i> Level 2 (3–4 marks) Describes ALL the purification steps AND Explains SOME purification steps. OR Describes AND explains a purification step AND Calculates correct mass of $\text{CH}_3\text{CH}_2\text{CHC}/\text{CH}_3$ OR Describes MOST purification steps AND Calculates mass of $\text{CH}_3\text{CH}_2\text{CHC}/\text{CH}_3$ with some errors <i>There is a line of reasoning presented with some structure. The information presented is relevant and supported by some evidence.</i> Level 1 (1–2 marks) Describes MOST purification steps OR Describes AND explains a purification step. OR Calculates a mass of $\text{CH}_3\text{CH}_2\text{CHC}/\text{CH}_3$ with some errors		- Distillation Explanations for each purification step - Separating funnel to separate the organic layer from aqueous layer AND Organic layer is the top layer - Dry (the organic layer) with an anhydrous salt OR Dry with MgSO_4 or CaCl_2 - Collect fraction at 70°C to separate product from unreacted reactants/side products IGNORE washing with carbonate/water <i>not in spec.</i> Calculation of mass of $\text{CH}_3\text{CH}_2\text{CHC}/\text{CH}_3$ Using moles method: $n(\text{CH}_3\text{CH}_2\text{CHOHCH}_3) = 9.25 / 74$ $= 0.125 \text{ (mol)}$ <i>moles of $\text{CH}_3\text{CH}_2\text{CHC}/\text{CH}_3$ for 65% yield</i> $= 0.125 \times 0.65 = 0.08125 \text{ (mol)}$ <i>mass for 65% yield</i> $= 0.08125 \times 92.5$ $= 7.52 \text{ g (3 sf)}$ <i>Calculator value: 7.51625 g</i> Using mass method: $n(\text{CH}_3\text{CH}_2\text{CHOHCH}_3) = 9.25 / 74$ $= 0.125 \text{ (mol)}$ <i>mass if 100% yield</i> $\text{CH}_3\text{CH}_2\text{CHC}/\text{CH}_3 = 0.125 \times 92.5$ $= 11.5625 \text{ g}$ <i>mass for 65% yield</i> $= 11.5625 \times 0.65$

Question			Answer	Mark	Guidance
			OR Describes a purification step AND attempts calculation of mass <i>There is an attempt at a logical structure with a line of reasoning. The information is in the most part relevant.</i> 0 marks <i>No response or no response worthy of credit.</i>		= 7.52 g (3 sf) CHECK for extent of errors by ECF ALLOW 3SF up to calculator value throughout TAKE CARE: values shown may be truncated calculator values. ALLOW for correct calculation, one small slip e.g using Mr of 73 instead of 74 or a rounding error Aspects of the communication statement might typically have been met when: • All information given is correct and relevant using appropriate scientific language • Purification steps are described in a logical order • Calculations are set out in a clear and logical way • No small slips/rounding errors • Final value for mass given to an appropriate number of significant figures/decimal places.
5	(d)	(i)		3	ALLOW any combination of skeletal OR structural OR displayed formula as long as unambiguous CHECK alkene carefully for correct number of Hs or missing CH₃ group. ALLOW names for reagents e.g. bromine if formula not given DO NOT ALLOW other additional reagents

Question			Answer	Mark	Guidance
			 Alkene X ✓ Stage 1: Br_2 ✓ Stage 2: NaOH/KOH ✓		IGNORE conditions e.g. reflux, heat IGNORE solvent For Stage 2: ALLOW $\text{OH}^-(\text{aq})$ OR any other hydroxide ALLOW H_2O but DO NOT ALLOW steam
5	(d)	(ii)	Nucleophilic substitution ✓	1	DO NOT ALLOW hydrolysis

Question			Answer	Mark	Guidance
6	(a)	(i)	P : CH_3CO^+ ✓ Q : $\text{CH}_3\text{COCH}_2\text{CH}_3^+$ ✓	2	ALLOW correct structural OR skeletal OR displayed formula OR mixture of the above for both structures + charge (anywhere on structure) required for each response ALLOW one mark if both formulae are correct but with no charge/incorrect charge ALLOW one mark if both formulae are correct but incorrectly labelled P/Q
6	(a)	(ii)	(M+1 peak due to small proportion of) Carbon-13 / C-13	1	
6	(b)	(i)	(causes bonds to) vibrate more (and absorb energy) ✓	1	DO NOT ALLOW Bond breaking

Question			Answer	Mark	Guidance
6	(b)	(ii)	Functional Group Alcohol OR Alkene✓ Name of functional group required not just bond Explanation O–H AND broad peak at 3200 - 3600 cm⁻¹ OR C=C AND sharp peak at 1620 -1680 cm⁻¹ ✓ Explanation must contain bond and either an appropriate range or value given within range stated.	2	Marks can be awarded from anywhere in response – does not need to be on the correct line. IGNORE Alkane DO NOT ALLOW any other functional group IGNORE 'hydroxyl' for 'alcohol' If no or incomplete explanation, check spectrum for annotations – credit can be given from correctly labelled peaks. ALLOW 'OH' or 'hydroxyl' for 'O-H' IGNORE all other bonds, except O-H and C=C, even if incorrect

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