



National
Qualifications
2026

2026 Chemistry

Higher - Paper 2

Question Paper Finalised Marking Instructions

These marking instructions have been prepared by examination teams for use by Qualifications Scotland appointed markers when marking external course assessments.

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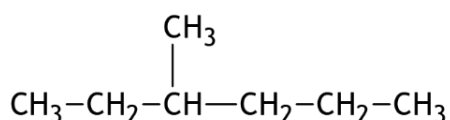
General marking principles for Higher Chemistry

Always apply these general principles. Use them in conjunction with the detailed marking instructions, which identify the key features required in candidates' responses.

- (a) Always use positive marking. This means candidates accumulate marks for the demonstration of relevant skills, knowledge and understanding; marks are not deducted for errors or omissions.
- (b) If a candidate response does not seem to be covered by either the principles or detailed marking instructions, and you are uncertain how to assess it, you must seek guidance from your team leader.
- (c) Do not award half marks.
- (d) Where a candidate makes an error at an early stage in a multi-stage calculation, award marks for correct follow-on working in subsequent stages, unless the error significantly reduces the complexity of the remaining stages. Apply the same principle for questions that require several stages of non-mathematical reasoning. The exception to this rule is where the marking instructions for a numerical question assign separate 'concept marks' and an 'arithmetic mark'. In such situations, the marking instructions will give clear guidance on the assignment or partial marks.
- (e) Unless a numerical question specifically requires evidence of working to be shown, award full marks for a correct final response (including units) on its own.
- (f) Candidates may fully access larger mark allocations whether their responses are in continuous prose, linked statements, or a series of developed bullet points.
- (g) Do not deduct marks for inaccurate or unconventional spelling or vocabulary as long as the meaning of the word(s) is conveyed. **For example**, responses that include 'distilling' for 'distillation', or 'it gets hotter' for 'the temperature rises', are acceptable.
- (h) In many questions, the unit in which the answer is to be expressed is given. In these questions, the candidate does not need to state a unit in their answer; but if they do, the unit must be correct. The full mark allocation cannot be awarded if an incorrect unit is shown. In these questions, incorrect units would only be penalised once in any paper.
- (i) If a correct response is followed by a wrong response, award no marks. **For example** in response to the question, 'State the colour seen when blue Fehling's solution is warmed with an aldehyde', do not award marks for the response 'red green'. However, if a correct response is followed by additional information which does not conflict with that, ignore the additional information, whether correct or not. **For example** in response to a question concerned with melting point, 'State why the tube should not be made of copper', the response 'Copper has a low melting point and is coloured grey' **would** gain marks.
- (j) Award full marks for the correct response to a calculation without working. Award partial marks, as shown in the detailed marking instructions, when working is given but the final response is incorrect. An exception is when candidates are asked to 'Find, by calculation' - do not award full marks for the correct response without working.
- (k) Ignore the omission of one H atom from a full structural formula provided the bond is shown.
- (l) Award marks for a symbol or correct formula in place of a name **unless stated otherwise in the detailed marking instructions**.

- (m) When formulae of ionic compounds are given as responses, candidates only need to show ion charges if these have been specifically asked for. However, if ion charges are shown, they must be correct. If incorrect charges are shown, do not award marks.
- (n) If an answer comes directly from the text of the question, do not award marks. **For example**, in response to the question, 'A student found that 0.05 mol of propane, C_3H_8 burned to give 82.4 kJ of energy. $\text{C}_3\text{H}_8(\text{g}) + 5\text{O}_2(\text{g}) \rightarrow 3\text{CO}_2(\text{g}) + 4\text{H}_2\text{O}(\ell)$. Name the kind of enthalpy change that the student measured', do not award marks for 'burning' since the word 'burned' appears in the text.
- (o) A guiding principle in marking is to give credit for correct elements of a response rather than to look for reasons not to give marks.

Example 1: The structure of a hydrocarbon found in petrol is shown below.



Name the hydrocarbon

- Award the full mark for '3, methyl-hexane', although the punctuation is not correct.

Example 2: A student measured the pH of four carboxylic acids to find out how their strength is related to the number of chlorine atoms in the molecule. The results are shown.

CH_3COOH	1.65
CH_2ClCOOH	1.27
CHCl_2COOH	0.90
CCl_3COOH	0.51

Describe the relationship between the number of chlorine atoms in the molecule and the strengths of the acids.

- Award the full mark for a response such as 'the more Cl_2 , the stronger the acid', although not completely correct.
- (p) Unless the question is clearly about a non-chemistry issue, for example costs in an industrial chemical process, do not award marks for a non-chemical response. **For example**, in response to the question, 'Why does the (catalytic) converter have a honeycomb structure?', do not award a mark for 'To make it work'. This response may be correct but it is not a chemical response.

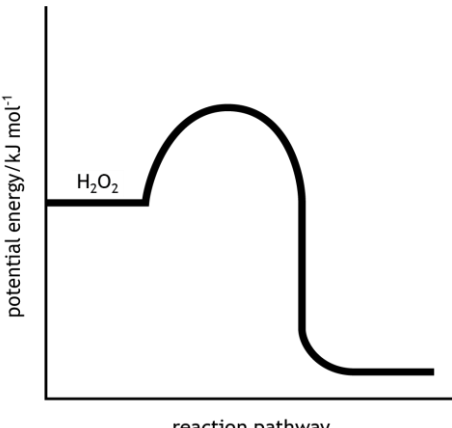
- (q) Only award marks for a valid response to the question asked. Where candidates are asked to:
- **identify, name, give or state**, they must only name or present in brief form.
 - **describe**, they must provide a statement or structure of characteristics and/or features.
 - **explain**, they must relate cause and effect and/or make relationships between things clear.
 - **compare**, they must demonstrate knowledge and understanding of the similarities and/or differences between things.
 - **complete**, they must finish a chemical equation or fill in a table with information.
 - **determine or calculate**, they must determine a number from given facts, figures or information.
 - **draw**, they must draw a diagram or structural formula, for example 'Draw a diagram to show the part of a poly(propene) molecule formed from two propene molecules.'
 - **estimate**, they must determine an approximate value for something.
 - **predict**, they must suggest what may happen based on available information.
 - **evaluate**, they must make a judgement based on criteria.
 - **suggest**, they must apply their knowledge and understanding of chemistry to a new situation. A number of responses are acceptable: award marks for any suggestions that are supported by knowledge and understanding of chemistry.
 - **use their knowledge of chemistry or aspect of chemistry to comment on**, they must apply their skills, knowledge and understanding to respond appropriately to the problem/situation presented (for example by making a statement of principle(s) involved and/or a relationship or equation, and applying these to respond to the problem/situation). Candidates gain marks for the breadth and/or depth of their conceptual understanding.
 - **write**, they must complete a chemical or word equation, for example 'Write the word equation for the complete combustion of ethanol.'

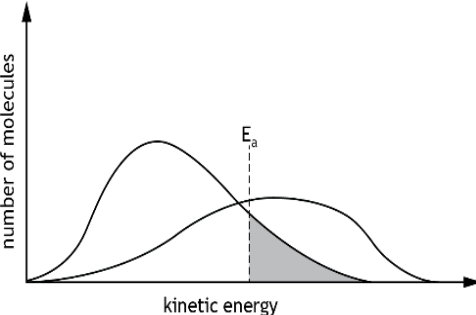
Marking instructions for each question

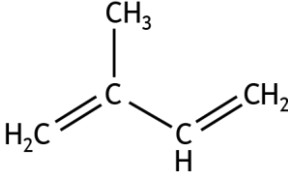
Question			Expected response	Max mark	Additional guidance
1.	(a)	(i)	Lattice	1	Accept network. Covalent or metallic cancels.
		(ii) (A)	Attraction between positive and negative (ions/particles/species). OR Attraction between opposite charges.	1	Do not accept mention of positive or negative atoms or molecules.
		(ii) (B)	There is a large difference in electronegativity (between sodium and chlorine). OR The electronegativity difference is 2.3.	1	Answer must make reference to difference.
	(b)	(i)	3	1	
		(ii)	100.714/100.71/100.7/101 (°C) Partial marks ----- Calculating $\Delta T_b = 0.714$. (1 mark) OR Evidence of adding an incorrectly calculated value of ΔT_b to 100. (1 mark)	2	Units are not required but must be correct if given. (Wrong units would only be penalised once in any paper).

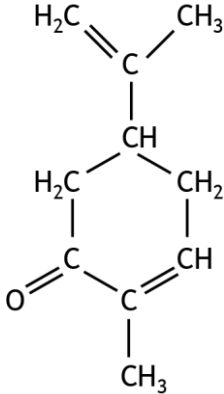
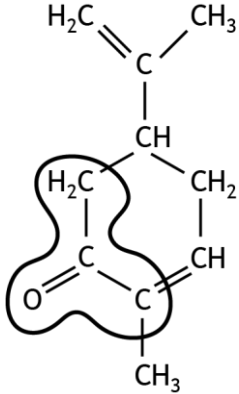
Question			Expected response	Max mark	Additional guidance
2.	(a)		1 mark for description of LDFs as forces of attraction between temporary dipoles (and induced dipoles). 1 mark for an explanation of the cause of temporary dipoles in terms of uneven distribution of electrons/ electron wobble/movement of electrons (in the molecule).	2	Attraction involving permanent dipoles cancels this mark.
	(b)		They have the same number of electrons. OR The strengths of the London dispersion forces are the same.	1	
	(c)		Water contains polar bonds. (1 mark) The shape of the molecule means that the dipoles are not cancelled out. OR Has an overall dipole. (1 mark)	2	

Question			Expected response	Max mark	Additional guidance
3.			Award 1 mark where the candidate has demonstrated, at an appropriate level, a limited understanding of the chemistry involved. They have made some statement(s) which are relevant to the situation, showing that they have understood at least a little of the chemistry within the problem. Award 2 marks where the candidate has demonstrated, at an appropriate level, a reasonable understanding of the chemistry involved. They make some statement(s) which are relevant to the situation, showing that they have understood the problem. Award 3 marks where the candidate has demonstrated, at an appropriate level, a good understanding of the chemistry involved. They show a good comprehension of the chemistry of the situation and provide a logically correct answer to the question posed. This type of response might include a statement of the principles involved, a relationship or an equation, and the application of these to respond to the problem. The answer does not need to be 'excellent' or 'complete' for the candidate to gain full marks. Award 0 marks where the candidate has not demonstrated, at an appropriate level, an understanding of the chemistry involved. There is no evidence that they have recognised the area of chemistry involved, or they have not given any statement of a relevant chemistry principle. Award this mark also if the candidate merely restates the chemistry given in the question.	3	

Question			Expected response	Max mark	Additional guidance
4.	(a)	(i)		1	The activation energy should be less than the enthalpy change. Shown by correct scale of diagram or correct numerical labels.
		(ii)	173 (kJ mol ⁻¹)	1	Units are not required but must be correct if given. (Wrong units would only be penalised once in any paper).
	(b)		A catalyst provides an alternative reaction pathway (1 mark) with a lower activation energy. OR Greater number of particles with energy greater than the activation energy. (1 mark)	2	
	(c)		0.17(g) Partial marks ----- No of moles oxygen 2.5×10^{-3}. (1 mark) OR Correct calculation of mass from an incorrect number of moles of oxygen (with mole ratio applied correctly). (1 mark) OR By proportion 68 grams $\longleftrightarrow$ 24 litres. (1 mark)	2	
	(d)	(i)	Atoms/molecules with unpaired electron(s).	1	Accept species in place of atoms or molecules. If reference is made to a singular atom, electron must also be singular.

Question			Expected response	Max mark	Additional guidance
4.	(d)	(ii)	$\bullet\text{OH}$ OR Hydroxyl	1	Accept $\text{OH}\bullet$. Hydroxide/ OH/OH^- not accepted.
	(e)	(i)	(The number of) molecules with energy greater than (or equal to) activation energy.	1	Accept (the number of) molecules with sufficient energy to form an activated complex/to allow a successful collision/to react.
		(ii)	 Second line displaced to right of original. Peak of curve should be further to the right and no higher than the original peak. (1 mark)	1	

Question			Expected response	Max mark	Additional guidance
5.	(a)		Non-water soluble OR Volatile	1	Any contradictory answer cancels.
	(b)	(i)		1	
		(ii)	2	1	
	(c)	(i)	Oils/limonene are non-polar. AND Hexane is non-polar.	1	
		(ii)	-4547.84 (kJ mol⁻¹) (3 marks) If incorrect answer given, a maximum of two partial marks can be awarded for demonstration of the two concepts: 1 mark for a demonstration of the correct use of the relationship $E_h = cm\Delta T$ as shown by $(4.18 \times (\text{an order of magnitude of } 0.5) \times 56)$ (ignore units for this partial mark). 1 mark for evidence of the knowledge that enthalpy of combustion relates to 1 mole, evidenced by the scaling up of a calculated value of energy released. - correct scaling of calculated E_h from 3.5 to 136 g $\begin{array}{lcl} 3.5 \text{ g} & \longleftrightarrow & E_h \\ 136 \text{ g} & \longleftrightarrow & \frac{136 \times E_h}{3.5} \end{array}$ $\frac{3.5}{136} (0.0257) \longleftrightarrow E_h$ $1 \longleftrightarrow X$	3	4547.84 (kJ mol⁻¹) (2 marks) No units required. If wrong unit is given (where no unit required, wrong units would only be penalised once in any paper). kJ is acceptable in place of kJ mol⁻¹ (KJ or Kj or KJ mol⁻¹ or Kj mol⁻¹ accepted).

Question			Expected response	Max mark	Additional guidance
5.	(d)	(i)	The carbon connected to the functional group/hydroxyl (group) is connected to two carbon atoms. OR The carbon connected to the functional group/hydroxyl is connected to one hydrogen atom.	1	
		(ii)		1	 Connectivity must be correct in the circled area.

Question			Expected response	Max mark	Additional guidance
6.	(a)	(i)	3-methylbutan-1-ol	1	
		(ii)	Brown (solid forms)	1	
	(b)		1314.78/1314.8/1315 g (2 marks) Partial marks ----- Calculating moles of ethene required (46.96). (1 mark) OR 4% taken of an incorrect number of moles (eg 27/23) and multiplied by 28 (g). OR 32,869.6 (g).	2	
	(c)	(i)	Proteins	1	
		(ii)	Intermolecular bonds/Van der Waals forces/Hydrogen bonds (within the protein) break. (1 mark) The protein changes shape/chains unwind. (1 mark)	2	

Question			Expected response	Max mark	Additional guidance
7.	(a)	(i)	<pre> graph TD ethene((ethene)) --> reactor[reactor
300°C
catalyst
pressure 60 atmospheres] water((water)) --> reactor reactor --> cooler[cooler] cooler --> mix1([ethanol, ethene
and water]) mix1 --> sep1[separator 1] sep1 --> ethene_recycle((ethene)) ethene_recycle --> ethene sep1 --> mix2([ethanol
and water]) mix2 --> sep2[separator 2] sep2 --> water_recycle((water)) water_recycle --> water sep2 --> ethanol((ethanol)) </pre>	1	Either arrow is accepted.
		(ii)	Distillation	1	
		(iii) (A)	Addition	1	
		(iii) (B)	Increasing pressure favours side with fewer moles of gas/gas molecules (or converse). (1 mark) Rate of forward reaction is increased/speeds up (by increasing pressure). (1 mark)	2	

Question			Expected response	Max mark	Additional guidance
7.	(a)	(iii) (C)	-41 (kJ mol⁻¹) Partial marks ----- The five relevant values for bond enthalpies of the C=C, C-H, O-H, C-O and C-C (or multiples thereof) are retrieved from the data booklet (614, 412, 463, 360 and 346 - ignore signs). (1 mark) OR If only four values are retrieved, the candidate recognises that bond breaking is endothermic and bond formation is exothermic and correctly manipulates the bond enthalpy values they have used to give their answer. (1 mark)	2	(+)41 (kJ mol⁻¹) would be awarded 1 mark. No units required. Only 1 mark can be awarded for the correct answer if wrong unit is given. kJ is acceptable in place of kJ mol⁻¹ (KJ or Kj or KJ mol⁻¹ or Kj mol⁻¹ accepted). (Wrong units would only be penalised once in any paper).
		(iii) (D)	No by-products/no waste products/ only one product. OR All the atoms in the reactants are converted into the product. OR Mass of product is equal to mass of reactants. OR The proportion of the total mass of all starting materials successfully converted into the desired product is 100%.	1	
	(b)	(i)	Increase in oxygen to hydrogen ratio/decrease in hydrogen to oxygen ratio.	1	
		(ii)	Ethanoic acid	1	

Question			Expected response	Max mark	Additional guidance
7.	(b)	(iii) (A)	Reactants or products are flammable/could catch fire.	1	
		(iii) (B)	Orange to green/blue-green/blue	1	
		(iii) (C)	$\text{C}_2\text{H}_5\text{OH} + \text{H}_2\text{O} \rightarrow \text{CH}_3\text{COOH} + 4\text{H}^+ + 4\text{e}^-$	1	Negative charge on the electron is not required.
		(iii) (D)	To supply the hydrogen ions (for the reaction).	1	
		(iii) (E)	Tertiary	1	
		(iv)	Fehling's (solution) OR Tollens' (reagent)	1	Accept Benedict's (solution).
	(c)	(i)	Diagram shows a workable method for the passing of ethanol vapour over heated aluminium oxide. Aluminium oxide must be labelled. (1 mark) Diagram allows ethene to be collected over water. (1 mark)	2	
		(ii)	Unsaturated.	1	

Question			Expected response	Max mark	Additional guidance
8.	(a)	(i)	Condensation	1	
		(ii)	$ \begin{array}{ccccccc} & \text{O} & \text{H} & \text{H} & \text{O} & \text{H} & \\ & & & & & & \\ \text{HO} - & \text{C} - & \text{C} - & \text{N} - & \text{C} - & \text{C} - & \text{NH}_2 \\ & & & & & & \\ & & \text{CH}_2 & & \text{H}_3\text{C} - & \text{CH} & \\ & & & & & & \\ & & \text{SH} & & & \text{CH}_2 & \\ & & & & & & \\ & & & & & \text{CH}_3 & \end{array} $ OR $ \begin{array}{ccccccc} & \text{O} & \text{H} & \text{H} & \text{O} & \text{H} & \\ & & & & & & \\ \text{HO} - & \text{C} - & \text{C} - & \text{N} - & \text{C} - & \text{C} - & \text{NH}_2 \\ & & & & & & \\ & & \text{H}_3\text{C} - & \text{CH} & & \text{CH}_2 & \\ & & & & & & \\ & & \text{CH}_2 & & & \text{SH} & \\ & & & & & & \\ & & \text{CH}_3 & & & & \end{array} $	1	Ignore incorrect connectivity in the side chains.
	(b)	(i) (A)	Hydrophobic	1	
		(i) (B)	The side chain contains a carboxyl/COOH group.	1	No mark can be awarded unless side chain is mentioned or indicated on structure.
		(ii)	Hydrogen bonds	1	
	(c)		(Strong) covalent bonds must be broken.	1	

Question			Expected response	Max mark	Additional guidance
9.			Award 1 mark where the candidate has demonstrated, at an appropriate level, a limited understanding of the chemistry involved. They have made some statement(s) which are relevant to the situation, showing that they have understood at least a little of the chemistry within the problem. Award 2 marks where the candidate has demonstrated, at an appropriate level, a reasonable understanding of the chemistry involved. They make some statement(s) which are relevant to the situation, showing that they have understood the problem. Award 3 marks where the candidate has demonstrated, at an appropriate level, a good understanding of the chemistry involved. They show a good comprehension of the chemistry of the situation and provide a logically correct answer to the question posed. This type of response might include a statement of the principles involved, a relationship or an equation, and the application of these to respond to the problem. The answer does not need to be 'excellent' or 'complete' for the candidate to gain full marks. Award 0 marks where the candidate has not demonstrated, at an appropriate level, an understanding of the chemistry involved. There is no evidence that they have recognised the area of chemistry involved, or they have not given any statement of a relevant chemistry principle. Award this mark also if the candidate merely restates the chemistry given in the question.	3	

Question			Expected response		Max mark	Additional guidance
10.	(a)	(i)	Condition	Increase/Decrease	1	
			Pressure	increase		
			Temperature	decrease		
			Concentration of ammonia in the reaction mixture	decrease		
		(ii)	No effect		1	
		(iii)	66.71/66.7/67 (%) Partial marking ----- Theoretical yield = 607 kg. OR Allow follow through from incorrect calculation of theoretical yield.		2	
	(b)		(+) 206(kJ mol ⁻¹) [(+283) + (726) + (-803)] = (+) 206 (kJ mol ⁻¹) Partial marks ----- Treat as two concepts. Either would be acceptable for 1 mark. Evidence of understanding of reversal of first and second enthalpy values e.g. +283 and + 242 (or multiples of +242) must be seen. The other enthalpy value (regardless of value) must be negative, or this partial mark cannot be awarded. OR Evidence of understanding of multiplying the second enthalpy value by 3. Ignore the enthalpy sign associated with these numbers. The other enthalpy values must not be multiplied, or this partial mark cannot awarded.		2	

Question			Expected response	Max mark	Additional guidance
10.	(c)	(i)	19/19.2/19.17 (%) Partial marks ----- Correct use of atom economy relationship ignoring stoichiometry (or with incorrect use of stoichiometry) (working must be shown). (1 mark) Correct working with no correct answer given. (1 mark) 0.19166 (1 mark)	2	
		(ii)	283.3 (hours) (2 marks) Partial marks ----- 17000 (minutes) OR 1020000 (seconds) (1 mark)	2	

Question			Expected response	Max mark	Additional guidance
11.	(a)	(i)	Standard (solution)	1	
		(ii)	1.125, 1.13, 1.1(g)	1	
		(iii)	2 marks from any of the following: - rinse beaker and transfer the rinsings/washings into the flask OR - transfer quantitatively into the flask (1 mark) - use deionised/distilled water (to make up to the mark) (1 mark) - make up so that the bottom of the meniscus meets the line (1 mark)	2	
	(b)	(i)	To determine the end point (of the reaction). OR The reaction is not self-indicating.	1	
		(ii)	1 mark for any of the following: - tap opened/solution drained to ensure no air bubbles - solution run onto the scale	1	
		(iii) (A)	1 mark for any of the following: - the first result is not concordant - it is the average of concordant results - or description of concordancy	1	

Question			Expected response	Max mark	Additional guidance
11.	(b)	(iii) (B)	0.111 (mol l⁻¹) Partial marks can be awarded using a scheme of two “concept” marks, and one “arithmetic” mark. 1 mark for knowledge of the relationship between moles, concentration and volume. This could be shown by one of the following steps: • calculation of moles oxalic acid solution e.g. $0.0517 \times 0.02695 = 0.00139$ • calculation of concentration of sodium hydroxide e.g. $0.002787 \div 0.025$ • insertion of correct pairings of values for concentration and volume in a valid titration formula If the relationship between moles, concentration and volume is used more than once, it must be used correctly every time. 1 mark for the relationship between a calculated number of moles of oxalic acid and sodium hydroxide. OR Insertion of correct stoichiometric values in a valid titration formula. 1 mark is awarded for correct arithmetic through the calculation. This mark can only be awarded if both concept marks have been awarded.	3	No units required. Only 2 marks can be awarded for the correct answer if wrong unit is given. (Wrong units would only be penalised once in any paper).
	(c)		$\text{Na}^+ - \text{O} - \text{C} \begin{array}{l} \nearrow \text{C} \searrow \\ \parallel \quad \parallel \\ \text{O} \quad \text{O} \end{array} \text{O} - \text{Na}^+$ OR Equivalent without charges as long as no covalent bond shown between Na and O.	1	

Question			Expected response	Max mark	Additional guidance
12.	(a)	(i)	Sodium and Cadmium Na and Cd	1	
		(ii)	Green	1	
	(b)	(i)	4.4 (mg l ⁻¹)	1	No units required. No mark can be awarded for correct answer if wrong unit is given (where no unit required, wrong units would only be penalised once in any paper). For any response other than 4.4, a line of best fit must be drawn and concentration at 40 checked with half box tolerance applied.
		(ii)	Hard (water)	1	
	(c)	(i)	$\text{He(g)} \rightarrow \text{He}^+(\text{g}) + \text{e}^-$	1	State symbols must be shown. Negative charge on the electron is not required.
		(ii)	Helium (only) has two electrons. OR No third electron in helium (atom).	1	

[END OF MARKING INSTRUCTIONS]