National Qualifications

X813/77/02 Chemistry

Marking Instructions

Please note that these marking instructions have not been standardised based on candidate responses. You may therefore need to agree within your centre how to consistently mark an item if a candidate response is not covered by the marking instructions.

General marking principles for Advanced 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) Award full marks for the correct response to a calculation (including units, if appropriate) without working. An exception to this is when candidates are asked to 'Find, by calculation' or 'Clearly show your working for the calculation'.

(e) Ideally, numerical values should be given to the correct number of significant figures as shown in the **detailed marking instructions**. Full marks can be awarded for values that have one significant figure fewer and up to two more significant figures than the expected answer. Exceptions to this rule will be given in the detailed marking instructions. Incorrect significant figures would only be penalised once in any paper and cannot be applied if marking instruction **(h)** has already been applied in the paper.

(f) Where a candidate makes an error at an early stage in a multi-stage calculation, award partial marks, as shown in the **detailed marking instructions**, 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 of partial marks.

(g) Ideally, calculated intermediate values should not be rounded. If the candidate has correctly rounded, the calculated intermediate values can have one significant figure fewer than the data given in the question but no fewer. **For example**, if the data in the question is given to three significant figures, the intermediate value should have no fewer than two significant figures.

(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 and cannot be applied if marking instruction **(e)** has already been applied in the paper.

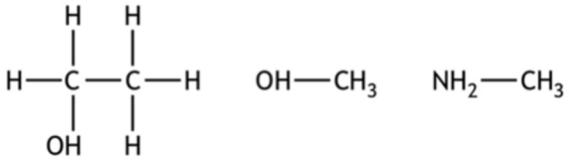
(i) Candidates may fully access larger mark allocations whether their responses are in continuous prose, linked statements, or a series of developed bullet points.

(j) 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. Exceptions to this rule will be given in the **detailed marking instructions**.

(k) If a correct response and a wrong response are given, 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.

(l) Ignore the omission of one H atom from a full structural formula provided the bond is shown. Ignore the omission of one bond provided the attached atom is shown.

If a structural formula is asked for, award marks only if the bond points to the appropriate atom. **For example**, the structural formulae shown below would not be awarded marks



This marking instruction must only be applied a maximum of once per question.

(m) Award marks for a symbol or correct formula in place of a name unless stated otherwise in the **detailed marking instructions**.

(n) 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.

(o) 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, burned to give 82·4 kJ of energy. $C_3H_8(g) + 5O_2(g) \rightarrow 3CO_2(g) + 4H_2O(\ell)$. Name the kind of enthalpy change that the student measured', do not award marks for 'burning' since the word 'burned' appears in the text.

(p) 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: If a structural formula is asked for, CH_3 and CH_3CH_2 are acceptable as methyl and ethyl groups respectively unless the question asks for a skeletal structural formula.

Example 2: If a name is asked for such as 3-methylhexane, then 3, methyl-hexane would be acceptable although the use of comma and dashes is not correct.

(q) 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.

(r) 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

Section 1

Question	Answer	Mark
1.	C	**1**
2.	A	**1**
3.	D	**1**
4.	C	**1**
5.	A	**1**
6.	C	**1**
7.	B	**1**
8.	D	**1**
9.	B	**1**
10.	A	**1**
11.	B	**1**
12.	C	**1**
13.	D	**1**
14.	C	**1**
15.	D	**1**
16.	B	**1**
17.	A	**1**
18.	D	**1**
19.	C	**1**
20.	A	**1**
21.	D	**1**
22.	B	**1**
23.	C	**1**
24.	A	**1**
25.	C	**1**

Section 2

Question			Expected response	Max mark	Additional guidance
1.	(a)		(Electrons) drop to lower (energy) levels	**1**	The words in brackets are not required.
	(b)	(i)	620 (nm) **(2)** Partial marking 1 mark may be awarded for one of the following: use of correct equations – $c=f\lambda$ AND $E = Lhf$ **OR** use of $E = \frac{Lhc}{\lambda}$ **OR** use of $\lambda = \frac{Lhc}{E}$ **OR** direct substitution into any of the correct equations above	**2**	Additional acceptable answers are 620·4/620·40 (general marking instruction (e)). As the lowest number of significant figures in the data is 3 the range in the answer can be between 2 and 5 significant figures. If intermediate rounding has taken place when using the $c=f\lambda$ and $E = Lhf$ separately then general marking instruction **(g)** applies. For an intermediate value of $4{\cdot}84 \times 10^{14}$ for frequency the acceptable answers are: 620/619·8/619·83 For an intermediate value of $4{\cdot}836 \times 10^{14}$ for frequency the acceptable answers are: 620/620·3/620·35 **There are other acceptable answers and if the answer given is not shown above, then the marker should perform the candidate's calculations to check that the answer is correct and complies with general marking instructions (e) and (g).** Units not required but must be correct if given. General marking instruction **(h)** applies.
		(ii)	Calcium	**1**	Allow follow through from b(i).
	(c)	(i)	(The (total) entropy of a reaction (system) and its surroundings always increases (for a spontaneous process)	**1**	The words in brackets are not required.

Question			Expected response	Max mark	Additional guidance
1.	(c)	(ii)	490 (K) **(2)** Partial marking 1 mark may be awarded for one of the following: Use of $\Delta G = \Delta H - T\Delta S$ **OR** Use of $T = \frac{\Delta H}{\Delta S}$ **OR** correct substitution of values directly into the above equations. **OR** reaction is feasible when $\Delta G = 0$	**2**	Additional acceptable answers are 500/491/491·2 (general marking instruction **(e)**). As the lowest number of significant figures in the data is 2 the range in the answer can be between 1 and 4 significant figures. Units not required but must be correct if given. General marking instruction **(h)** applies.

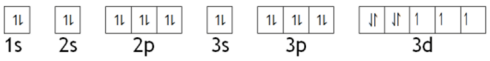
Question			Expected response	Max mark	Additional guidance
2.	(a)		Octahedral	**1**	
	(b)		7	**1**	
	(c)	(i)	Amminepentaaquanickel(II) **OR** monoamminepentaaquanickel(II)	**1**	The name of the complex ion must be spelled exactly as shown.
		(ii)	Forms only one bond (to the metal) **OR** donates/shares one (lone/non-bonding) pair of electrons	**1**	The words in brackets are not required.
	(d)	(i)	2/2nd/second	**1**	Two is not an acceptable answer.
		(ii)	5200 **(1)** l mol^{-1} s^{-1} **(1)**	**2**	The units can be in any order.

Question			Expected response	Max mark	Additional guidance
3.	(a)	(i)	sp^2	**1**	The number 2 does not need to be superscripted but must come after the 'sp'.
		(ii)	Side-on overlap of (parallel atomic/p) orbitals (that lie perpendicular to the axis of the covalent bond)	**1**	The words in brackets are not required. The mention of overlap of molecular orbitals is not acceptable. No mark is awarded if any mention or drawing of s orbitals
		(iii)	Short conjugated system **OR** few atoms in the conjugated system **OR** delocalised electrons over a small number of carbon atoms **OR** molecular orbital over a small number of carbon atoms **(1)** **AND** A large amount of energy is required to promote an electron from HOMO to LUMO **OR** Large energy gap between HOMO and LUMO **OR** the energy gap between HOMO and LUMO is not small enough to absorb visible light **(1)**	**2**	
	(b)	(i)	(electrophilic) substitution	**1**	The words in brackets are not required. Nucleophilic substitution is awarded zero marks
		(ii)	C_9H_{12}	**1**	
		(iii)	More stable carbocation formed **OR** Secondary carbocation is more stable than primary carbocation	**1**	

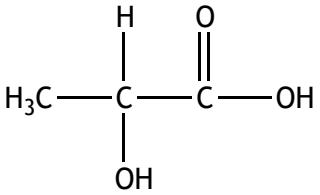
Question			Expected response	Max mark	Additional guidance
4.	(a)		Calcium carbonate/limestone is insoluble.	**1**	
	(b)	(i)	Moles of HCl = 0·0253 **(2)** Partial marking 1 mark may be awarded for one of the following: calculating moles of NaOH in the 10·15 cm^3 average titre volume ($3·045 \times 10^{-3}$ moles) **OR** correctly multiplying an incorrectly calculated moles of NaOH in titre volume or moles of unreacted HCl in the sample by 4 **OR** correctly subtracting a calculated number of moles of HCl, left unreacted in the volumetric flask, from the number of moles of HCl at the start **(1)**	**2**	Additional acceptable answers are 0·025/0·02532 (general marking instruction **(e)**). As the lowest number of significant figures in the data is 3 the range in the answer can be between 2 and 5 significant figures. If intermediate rounding has taken place then general marking instruction **(e)** applies.

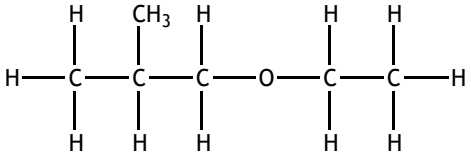
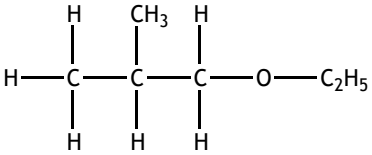
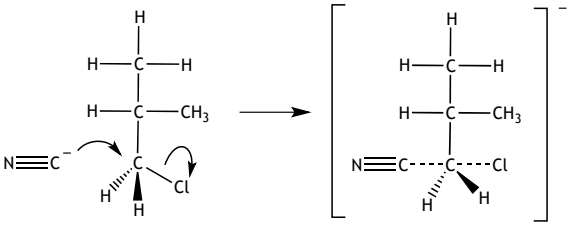
Question			Expected response	Max mark	Additional guidance
4.	(b)	(ii)	97·4% and yes **(2)** Partial marking 1 mark may be awarded for one of the following: applying the 2:1 mole ratio to determine the moles of calcium carbonate present. **OR** correctly calculating a mass of calcium carbonate from an incorrect number of moles **OR** correctly calculating a percentage $CaCO_3$ from an incorrect mass	**2**	Additional acceptable answers are 97/97·41/97·405 (general marking instruction **(e)**). As the lowest number of significant figures in the data is 3 the range in the answer can be between 2 and 5 significant figures. A correct numerical answer and yes, with no working, would be awarded 2 marks. If intermediate rounding has taken place then general marking instruction **(g)** applies. If the mass of $CaCO_3$ is rounded to 1·27 g then the acceptable answers are 97/97·7/97·69/97·692 Allow follow through from (b)(i). If the candidate uses the answer 0·02532 from (b)(i) then the acceptable answers are 97/97·5/97·48/97·482 **There are other acceptable answers and if the answer given is not shown above, then the marker should perform the candidate's calculations to check that the answer is correct and complies with general marking instructions (e) and (g).** A maximum of 1 mark should be awarded if the candidate has not correctly indicated whether the limestone is suitable from their own calculated results.

Question			Expected response	Max mark	Additional guidance
4.	(c)		**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 2 marks** where the candidate has demonstrated, at an appropriate level, a reasonable understanding of the chemistry involved. They make some statement(s) that are relevant to the situation, showing that they have understood the problem. **Award 1 mark** where the candidate has demonstrated, at an appropriate level, a limited understanding of the chemistry involved. They make some statement(s) that are relevant to the situation, showing that they have understood at least a little of the chemistry within the problem. **Award 0 marks** where the candidate has not demonstrated 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**	Candidates may use a variety of chemistry arguments to answer this question. Award marks based on candidates demonstrating overall good, reasonable, limited, or no understanding.

Question			Expected response	Max mark	Additional guidance
5.	(a)	(i)	$1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^7$ **OR**  	**1**	Non-superscripted numbers are acceptable. All of the orbital boxes opposite must be shown and clearly labelled. Single or double headed arrows are acceptable. Accept diagrams showing an empty 4s orbital box.
		(ii)	2+/+2	**1**	Number can be in words/numerals but must include the charge/sign.
	(b)	(i)	Heating substance **(1)** **All three** of the following are required for 1 mark: Cool/leave in a desiccator (to prevent absorption of water) **AND** Weigh **AND** Repeat (the steps of heating, cooling and weighing) to constant mass **(1)**	**2**	The words in brackets are not required.
		(ii)	6 **(2)** Partial marking 1 mark may be awarded for one of the following: Correctly calculating moles of H_2O (0·00933) **AND** moles of $CoCl_2$ (0·00157) **OR** correctly calculating the GFM of $CoCl_2 \cdot nH_2O$ (0·372/0·00157 = 236·9) **AND** correctly calculating the mass of water by subtracting the GFM of $CoCl_2$ (236·9-129·9 = 107) **OR** correctly calculating a value for *n* using incorrect moles of $CoCl_2$ or H_2O **OR** correctly calculating a value for n using incorrect GFM for $CoCl_2 \cdot nH_2O$ or $CoCl_2$.	**2**	General marking instruction **(e) does not** apply as the answer given must be a whole number. An answer of 6 with no working would be awarded **zero marks**. If intermediate rounding has taken place then general marking instruction **(g)** applies.

Question			Expected response	Max mark	Additional guidance
5.	(c)	(i)	EDTA	**1**	
		(ii)	Colorimetry **OR** Spectrophotometry **OR** Atomic emission/absorption spectroscopy **OR** Precipitation	**1**	

Question			Expected response	Max mark	Additional guidance
6.	(a)		The candidate answer must show that they have correctly worked out the number of moles of each element: 3·33 C; 6·70 H; 3·33 O	**1**	
	(b)	(i)	$C_3H_6O_3$	**1**	The elements can be in any order.
		(ii)	$[COOH]^+$ / $[CO_2H]^+$ **OR** ^+COOH / $^+CO_2H$ **OR** $[CH_3CHOH]^+$ / $[C_2H_5O]^+$ **OR** CH_3C^+HOH / $^+C_2H_5O$ **OR** $[CH_3CH_2O]^+$ **OR** $CH_3CH_2O^+$ / $C_2H_5O^+$	**1**	Positive charge must be present. The positive charge must **not** be on a hydrogen atom, for example, $COOH^+$ Round brackets are also acceptable.
	(c)		 **OR** $CH_3CH(OH)COOH$ **OR** any other correct structural formula	**1**	Markers should check that the connectivity of the atoms is correct – general marking instruction **(l)**.

Question			Expected response	Max mark	Additional guidance
7.	(a)		 **OR**  **OR** any other correctly drawn structural formula	**1**	Markers should check that the connectivity of the atoms is correct – general marking instruction **(l)**.
	(b)		Carboxylic acids	**1**	
	(c)		Two correct curly arrows (1)  Transition state (1)	**2**	Double arrow heads are required for both curly arrows. The curly arrow from the nucleophile must come from the carbon and point to the space between this carbon and the correct carbon in the haloalkane. The other curly arrow must start from the middle of the C — Cl bond and point towards the chlorine atom. Transition state must be inside brackets with a negative charge outside of the brackets. Markers should check that the connectivity of all of the atoms is correct in the transition state structure - general marking instruction **(l)** applies.
	(d)	(i)	Ethanol/alcohol	**1**	

Question			Expected response	Max mark	Additional guidance
7.	(d)	(ii)	278 cm^3/0·278 l **(3)** Partial marking 1 mark may be awarded for the correct unit for a calculated final volume. **(1)** 1 mark may also be awarded for one of the following: Correctly calculating the theoretical yield of methylpropene - 460 (cm^3) / 0·46 (l) / 1·12 (g) **OR** correctly calculating 60.4% of an incorrect theoretical yield **OR** correctly calculating 60·4% of 0·02 moles (theoretical) methylpropene (0·01208 moles). **OR** correctly multiplying an incorrect moles (actual) methylpropene by 23.	**3**	Correct units are required in this question. L is also an acceptable abbreviation for litres. Additional acceptable answers are: 280/277·8/277·84 (cm^3) **OR** 0·28/0·2778/0·27784 (l) (general marking instruction **(e)**). As the lowest number of significant figures in the data is 3 the range in the answer can be between 2 and 5 significant figures. General marking instruction **(g)** applies to the calculation and so alternative answers are shown below: If 0·0121 moles of methylpropene is used then the acceptable answers are: 280/278/278·3 (cm^3) **OR** 0·28/0·278/0·2783 (l) If 0·012 moles of methylpropene is used then the acceptable answers are: 280/276 (cm^3) **OR** 0.28/0.276 (l) 0·02 is an acceptable number of moles of methylpropene rather than 0·0200 in this question. **There are other acceptable answers and if the answer given is not shown above, then the marker should perform the candidate's calculations to check that the answer is correct and complies with general marking instructions (e) and (g).**

Question			Expected response	Max mark	Additional guidance
8.	(a)		CH_3COO^- **OR** any correct structural formula	**1**	Negative charge must be present on the O.
	(b)	(i)	4·36 **(3)** Partial marking 1 mark may be awarded for: correctly calculating concentration of sodium ethanoate = 0·200 (mol l^{-1}) 1 mark may also be awarded for one of the following: $pH = pK_a - \log_{10}\frac{[\text{acid}]}{[\text{salt}]}$ **OR** direct substitution of values into $pH = pK_a - \log_{10}\frac{[\text{acid}]}{[\text{salt}]}$	**3**	Additional acceptable answers are: 4·4/4·362/4·3621 (general marking instruction **(e)**). As the lowest number of significant figures in the data is 3 the range in the answer can be between 2 and 5 significant figures. The volume of the 250 cm^3 of buffer solution is taken as being to 3 significant figures since it would have been made up in a standard flask. General marking instruction **(g)** applies to this calculation. However, 0·2 (mol l^{-1}) is acceptable for the concentration of sodium ethanoate rather than 0·200. **There are other acceptable answers and if the answer given is not shown above, then the marker should perform the candidate's calculations to check that the answer is correct and complies with general marking instructions (e) and (g).** **Award 2 marks** for correctly calculating a pH from an incorrect sodium ethanoate concentration**.**
		(ii)	The concentration of the acid and salt will change by the same amount **OR** the acid and the salt are diluted by the same amount **OR** (the concentration) ratio of the acid and salt is unchanged	**1**	The words in brackets are not required.

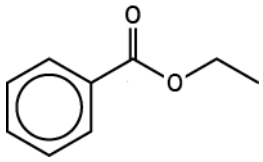
Question			Expected response	Max mark	Additional guidance
	(c)		Use the same volume of each buffer solution **(1)** Then, measure the (rise/change in) pH after the same volume/moles of alkali has been added **OR** the solution which shows the smallest change in pH when the same volume/moles of alkali has been added has the larger buffer capacity **OR** measure the volume of alkali required to raise the pH by the same value/from pH5 to 6. **(1)**	**2**	Candidates may mention specific quantities in their experimental procedure and as long as they fit with the general procedures opposite then the marks should be awarded. The words in brackets are not required. Other specific pH changes are acceptable as long they are from pH5 to a higher value and it's clear the same pH change is used for both buffers.

Question			Expected response	Max mark	Additional guidance
9.	(a)		(A substance that) alters the biochemical processes in the body.	**1**	The words in brackets are not required.
	(b)		Inhibitor	**1**	
	(c)		2500 (ppm)	**1**	Additional acceptable answers are: 2000/2480/2483 (general marking instruction **(e)**). As the lowest number of significant figures in the data is 2 the range in the answer can be between 1 and 4 significant figures. If intermediate rounding has taken place then general marking instruction **(g)** applies. If mass of methotrexate in the dose is rounded to 5·7 mg then the acceptable answers are: 2000/2500/2480/2478 Units not required but must be correct if given. General marking instruction **(h)** applies.

Question			Expected response	Max mark	Additional guidance
	(d)		**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 2 marks** where the candidate has demonstrated, at an appropriate level, a reasonable understanding of the chemistry involved. They make some statement(s) that are relevant to the situation, showing that they have understood the problem. **Award 1 mark** where the candidate has demonstrated, at an appropriate level, a limited understanding of the chemistry involved. They make some statement(s) that are relevant to the situation, showing that they have understood at least a little of the chemistry within the problem. **Award 0 marks** where the candidate has not demonstrated 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**	Candidates may use a variety of chemistry arguments to answer this question. Award marks based on candidates demonstrating overall good, reasonable, limited, or no understanding.

Question			Expected response	Max mark	Additional guidance
10.	(a)	(i)	58·1 (g) Partial marking 1 mark may be awarded for: correctly calculating the value for n = 0·00892 **OR** correctly calculating a GFM using an incorrect value for n **(1)**	**2**	Additional acceptable answers are: 58/58·09/58·088 (general marking instruction **(e)**). As the lowest number of significant figures in the data is 3 the range in the answer can be between 2 and 5 significant figures. A correct answer with no working is worth 2 marks. If intermediate rounding has taken place then general marking instruction **(g)** applies. If the value for n used is 0·0089 then the acceptable answers are: 58/58·2/58·20/58·202 If the value for n used is 0·00892 then the acceptable answers are: 58/58·1/58·07/58·072 If the value for n used is 0·008918 then the acceptable answers are: 58/58·1/58·08/58·085 Units not required but must be correct if given. General marking instruction **(h)** applies.
		(ii)	Propanone/propanal **OR** C_2H_6O **OR** a correct structural formula for propanone/propanal **OR** any other carbonyl compound that fits the GFM calculated in (a)(i).	**1**	
	(b)		The boiling point (of butanoic acid) is above 100 °C/the boiling point of water **OR** the water (bath) cannot reach a high enough temperature.	**1**	The words in brackets are not required.

Question			Expected response	Max mark	Additional guidance
11.	(a)	(i)	$K = \frac{\left[I_3^-(aq)\right]}{\left[I_2(aq)\right]\left[I^-(aq)\right]}$ **OR** $K = \frac{\left[I_3^-\right]}{\left[I_2\right]\left[I^-\right]}$	**1**	State symbols are not required but any that are given must be correct. Ion charges must be shown. Square brackets must be used.
		(ii)	779 Partial marking 1 mark may be awarded for one of the following: calculating the equilbrium concentration of I^- = 0·123 (mol l^{-1}) **OR** correctly calculating a value for *K* using an incorrect concentration for one of the species.	**2**	Additional acceptable answers are: 780/779·4/779·41 (general marking instruction **(e)**). As the lowest number of significant figures in the data is 3 the range in the answer can be between 2 and 5 significant figures. If intermediate rounding has taken place then general marking instruction **(g)** applies. If the candidate incorrectly uses 0·239 mol l^{-1} for the concentration of I^-, the acceptable values for **1 mark** are: 401/401·1/401·12 There are no units for an equilibrium constant. Therefore, if any units are given they will be incorrect and general marking instruction **(h)** applies.
	(b)		Structure depends on VSEPR/ minimising repulsion/minimising repulsion between lone/non-bonding pairs **OR** repulsion is greatest between lone/non-bonding pairs (1) (In B) the lone/non-bonding pairs are 120° from one another **OR** in A the lone/non-bonding pairs are 90° from one another **OR** the angle is greater between lone/non-bonding pairs (in B) **OR** the lone/non-bonding pairs are further away from each other (in B) **(1)**	**2**	

Question			Expected response	Max mark	Additional guidance
12.	(a)			**1**	
	(b)		To prevent reactant/product/vapour from escaping **OR** to allow prolonged heating	**1**	
	(c)		Distillation	**1**	
	(d)		Elimination	**1**	
	(e)		(Slightly) positively charged hydrogen (in HBr) **OR** 	**1**	The words in brackets are not required.
	(f)	(i)	The (benzoate) ion from the salt removes/reacts with H^+ from the water **OR** the conjugate base of the weak acid, removes/reacts with H^+ ions from the water **(1)** This results in the water equilibrium shifting to the right hand side **OR** shifting to the left hand side if candidate has written an equilibrium reaction with ions on the left hand side **OR** this results in excess OH^- ions from the water equilibrium. **(1)**	**2**	The words in brackets are not required. Zero marks are awarded for "It is the salt of a strong base and a weak acid" without further explanation.
		(ii)	Filtration	**1**	
	(g)		Recrystallisation	**1**	

Question			Expected response	Max mark	Additional guidance
12.	(h)	(i)	Pure benzoic acid	**1**	
		(ii)	Any mention of measuring or looking up the melting point of pure benzoic acid **(1)** Correctly linking the mixed melting point value to the purity **(1)**	**2**	The statement "The sample is pure if the mixed melting point is the same as pure benzoic acid," would be awarded **2 marks**. The statement, "The sample is impure if the mixed melting point is lower than pure benzoic acid," would also be awarded **2 marks**.
	(i)		Spectrum C No C=O peak at 1700 cm^{-1} in spectrum C **OR** spectra A and B have a C=O peak at 1700 cm^{-1}. (1)	**2**	

[END OF MARKING INSTRUCTIONS]