

General marking guidance

- All candidates must receive the same treatment. Examiners must mark the first candidate in exactly the same way as they mark the last.
- Mark schemes should be applied positively. Candidates must be rewarded for what they have shown they can do rather than penalised for omissions.
- Examiners should mark according to the mark scheme not according to their perception of where the grade boundaries may lie.
- There is no ceiling on achievement. All marks on the mark scheme should be used appropriately.
- All the marks on the mark scheme are designed to be awarded. Examiners should always award full marks if deserved, i.e. if the answer matches the mark scheme. Examiners should also be prepared to award zero marks if the candidate's response is not worthy of credit according to the mark scheme.
- Where some judgement is required, mark schemes will provide the principles by which marks will be awarded and exemplification may be limited.
- When examiners are in doubt regarding the application of the mark scheme to a candidate's response, the team leader must be consulted.
- Crossed-out work should be marked UNLESS the candidate has replaced it with an alternative response.
- Mark schemes will indicate within the table where, and which strands of Quality of Written Communication, are being assessed. The strands are as follows:
 - i. ensure that text is legible and that spelling, punctuation and grammar are accurate so that meaning is clear
 - ii. select and use a form and style of writing appropriate to purpose and to complex subject matter
 - iii. organise information clearly and coherently, using specialist vocabulary when appropriate.

Using the Mark Scheme

Examiners should NOT give credit for incorrect or inadequate answers, but allow candidates to be rewarded for answers showing correct application of principles and knowledge. Examiners should therefore read carefully and consider every response: even if it is not what is expected, it may still be creditworthy.

The mark scheme gives examiners:

- an idea of the types of response expected
- how individual marks are to be awarded
- the total mark for each question
- examples of responses that should NOT receive credit.

/	Means that the responses are alternatives and either answer should receive full credit.
()	Means that a phrase/word is not essential for the award of the mark, but helps the examiner to get the sense of the expected answer.
Bold	Phrases/words in bold indicate that the meaning of the phrase or the actual word is essential to the answer.
ecf/TE/cq	(error carried forward)(transfer error)(consequential) means that a wrong answer given in an earlier part of a question is used correctly in answer to a later part of the same question.

Candidates must make their meaning clear to the examiner to gain the mark. Do not give credit for correct words/phrases which are put together in a meaningless manner. Answers must be in the correct context.

Question Number	Acceptable Answer	Reject	Mark
1(a)(i)	Green IGNORE qualifications of green such as light/dark/emerald. (1)	Blue-green	(3)
	Carbon dioxide ALLOW CO ₂ . (1)	Turquoise	
	CO ₃ ²⁻ ALLOW HCO ₃ ⁻ (1)		

Question Number	Acceptable Answer	Mark
1(a)(ii)	[NiCl ₄] ²⁻ ALLOW -2 for 2- NiCl ₄ ²⁻ [Ni(Cl) ₄] ²⁻ Ni(Cl) ₄ ²⁻ [Ni(H ₂ O) ₂ Cl ₄] ²⁻ [NiCl ₆] ⁴⁻	(1)

Question Number	Acceptable Answer	Mark
1(a)(iii)	Ni(OH) ₂ /Ni(H ₂ O) ₄ (OH) ₂ / Ni(OH) ₂ (H ₂ O) ₄ / [Ni(H ₂ O) ₄ (OH) ₂]/ [Ni(OH) ₂ (H ₂ O) ₄]	(1)

Question Number	Acceptable Answer	Reject	Mark
1(a)(iv)	Blue solution (forms)		(1)
	ALLOW lavender blue solution and any other shade of blue. OR (Green) precipitate dissolves.	Blue-green Precipitate dissolves to give incorrect coloured solution	

Question Number	Acceptable Answer	Mark
1(b)(i)	$24.2/1000 \times 0.01 = 2.42 \times 10^{-4}$ (mol) (1)	(2)
	Concentration of $[\text{Ni}(\text{H}_2\text{O})_6]^{2+}$ ions = $2.42 \times 10^{-4} \times 100 = 0.0242$ (mol dm ⁻³) (1)	
	ALLOW TE on number of moles.	
	Correct answer alone scores both marks. IGNORE significant figures except 1.	

Question Number	Acceptable Answer	Reject	Mark
1(b)(ii)	$0.1/24.2 \times 100 = (\pm) 0.413\%$ / $(\pm) 0.41\%$ / $(\pm) 0.4\%$	4 or more SF	(1)

Question Number	Acceptable Answer	Reject	Mark
1(b)(iii)	(Mean) titre would be greater. (1)	More needed to react with unspecified impurity	(2)
	EDTA ⁽⁴⁻⁾ would also complex to/react with $\text{Cu}^{2+}/[\text{Cu}(\text{H}_2\text{O})_6]^{2+}/\text{CuSO}_4$ /copper ions/copper sulphate. (1) Both marks are stand alone.		

Total for Question 1 = 11 Marks

Question Number	Acceptable Answer	Reject	Mark
2(a)	Smoky/sooty flame IGNORE reference to yellow flame.	White smoke	(1)

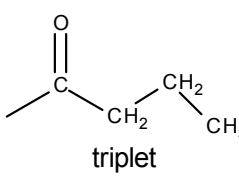
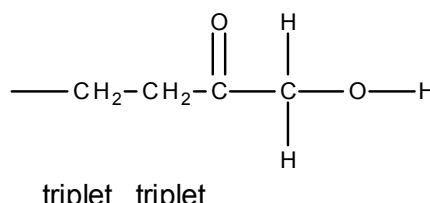
Question Number	Acceptable Answer	Reject	Mark
2(b)(i)	It contains a phenol group/has OH attached to benzene ring. ALLOW hydroxyl group attached to benzene ring. ALLOW 'is a phenol'. ALLOW drawn benzene ring with OH.	Just OH group Hydroxide group	(1)

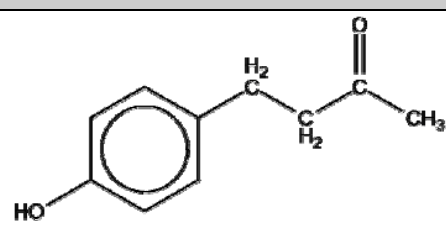
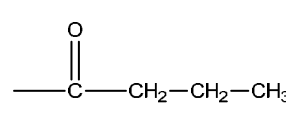
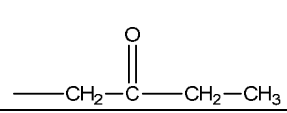
Question Number	Acceptable Answer	Reject	Mark
2(b)(ii)	It could be an aldehyde or a ketone/contains a carbonyl group. ALLOW C=O.	Either aldehyde or ketone on its own	(1)

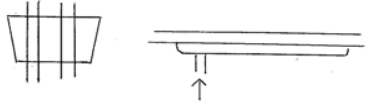
Question Number	Acceptable Answer	Mark
2(b)(iii)	X is a ketone ALLOW aromatic ketone. ALLOW R-CO-R. ALLOW not an aldehyde if both ketone and aldehyde mentioned in b(ii).	(1)

Question Number	Acceptable Answer	Reject	Mark
2(c)(i)	(Hydrogen atoms/protons on) benzene ring/phenyl group/arene ring.	Hydrogen atoms in phenol	(1)

Question Number	Acceptable Answer	Reject	Mark
2(c)(ii)	<p>To score any marks in this question the side chain must be:</p> <p>(a)</p> $\text{---CH}_2\text{---CH}_2\text{---}\overset{\text{O}}{\parallel}\text{C---CH}_3$ <p>OR</p> <p>(b)</p> $\overset{\text{O}}{\parallel}\text{C---CH}_2\text{---CH}_2\text{---CH}_3$ <p>OR</p> <p>(c)</p> $\text{---CH}_2\text{---CH}_2\text{---}\overset{\text{O}}{\parallel}\text{C---}\underset{\text{H}}{\overset{\text{H}}{\text{C}}}\text{---O---H}$ <p>Ketone on correct carbon Structure (a) or structure (c) (1)</p> <p>ALLOW displayed or skeletal</p> <p>ALLOW CH₂CH₂COCH₃</p> <p>IGNORE presence or position of OH on the benzene ring</p> $\begin{array}{c} \text{H}_2 \\ \\ \text{---C---} \\ \\ \text{---C---} \\ \\ \text{H}_2 \end{array} \quad \begin{array}{c} \text{O} \\ \\ \text{---C---} \\ \\ \text{CH}_3 \end{array}$ <p>triplet triplet singlet</p> <p>Both triplets labelled. (1) Singlet labelled. (1)</p>	Any other side chain scores zero for 2c(ii)	(3)

Question Number	Acceptable Answer	Mark
2(c)(ii) continued	<p>ALLOW</p> <p>If the side chain is (b) the triplet CH₂ next to the C=O correctly labelled scores one mark.</p>  <p style="text-align: right;">(1)</p> <p>If the side chain is (c) the triplets, both labelled, score the mark.</p>  <p style="text-align: right;">(1)</p>	

Question Number	Acceptable Answer	Reject	Mark
2(c)(iii)	 <p>IGNORE position of OH and side chain on the ring.</p> <p>ALLOW displayed or skeletal.</p> <p>ALLOW C₆H₄(OH)CH₂CH₂COCH₃.</p> <p>ALLOW TE if one of the following side chains is carried forward from 2c(ii):</p>  <p>OR</p> 	TE for any other side chain	(1)

Question Number	Acceptable Answer	Reject	Mark
2(d)	<p>Steam source with delivery tube to flask with the steam passing into the liquid in the flask.</p> <p>IGNORE incorrectly positioned safety vents in the steam generator.</p> <p>OR</p> <p>Flask being heated and containing water (and raspberries). (1)</p> <p>Condenser with water jacket in correct position and with correct direction of water flow shown. (1)</p> <p>Collection vessel. (1)</p> <p>Minus 1 mark if apparatus does not work (e.g. sealed or leaky joints)</p>  <p>Correctly drawn reflux apparatus scores 1 mark.</p> <p>IGNORE fractionating columns.</p> <p>Collection vessel may be any shape of flask, test tube or cylinder.</p>	<p>Steam delivered above the liquid in the flask</p> <p>Unlabelled liquid in the flask</p>	(3)

Total for Question 2 = 12 Marks

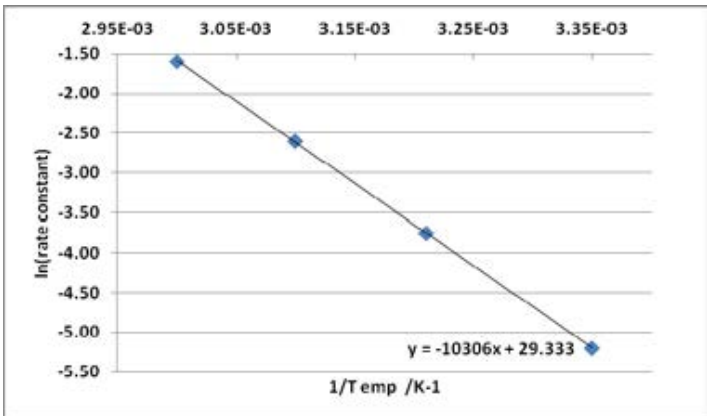
Question Number	Acceptable Answer	Reject	Mark
3(a)(i)	Burette/(graduated/volumetric) pipette (1) Allows accurate/precise measurement. (1) OR Measuring cylinder. (1) Allows you to do multiple experiments quickly/accurate enough (to determine orders). (1) IGNORE Ease of use. Cylinder allows variety of different volumes to be measured.	Dropping/teat pipette	(2)

Question Number	Acceptable Answer	Reject	Mark
3(a)(ii)	Pink/purple (1) To colourless (1) Reverse order scores 1 mark.	Lilac Clear for colourless	(2)

Question Number	Acceptable Answer	Reject	Mark
3(a)(iii)	To keep the (overall) volume constant/50 cm ³ OR So the concentration of each reactant is proportional to the volume used.	Any other volume quoted	(1)

Question Number	Acceptable Answer	Reject	Mark
3(a)(iv)	(Monitor change in concentration of MnO ₄ ⁻ using) colorimetry. OR Titrate with reducing agent/named reducing agent, e.g. Fe ²⁺ .	Just observing the intensity of the colour Electrical conductivity pH meter Just 'titrate'	(1)

Question Number	Acceptable Answer	Reject	Mark
3(a)(v)	<p>0 order with respect to glucose 1st order with respect to sulfuric acid 1st order with respect to potassium manganate (VII)</p> <p>All 3 correct scores 2 marks 2 correct scores 1 mark 0 or 1 correct scores 0 marks (2)</p> <p>Rate/r/R = $k[\text{MnO}_4^-][\text{H}^+][\text{C}_6\text{H}_{12}\text{O}_6]^0$ (1)</p> <p>ALLOW full formulae or names in rate equation.</p> <p>If formulae given they must be correct.</p> <p>ALLOW 'K' for 'k'.</p> <p>ALLOW TE from incorrect orders for last mark.</p>	Rate equation for rate	(3)

Question Number	Acceptable Answer	Mark
3(b)(i)	 <p>Suitable linear scales. (1)</p> <p>IGNORE units.</p> <p>Points plotted correctly. (1)</p> <p>Straight line of best fit drawn. (1)</p>	(3)

Question Number	Acceptable Answer	Reject	Mark
3(b)(ii)	Gradient = -10300 ALLOW any value in the range -9600 to -11000 IGNORE units even if incorrect	Positive gradient	(1)

Question Number	Acceptable Answer	Reject	Mark																																
3(b)(iii)	$E_A = (-)$ gradient from b(ii) $\times 8.31$ (1) $E_A =$ Value to at least 2 significant figures with units. (1) Units must be correct. Correct value: $E_A = -(-10300) \times 8.31$ $= 85593 \text{ J mol}^{-1}/85.6 \text{ kJ mol}^{-1}$ Correct answer with no working scores both marks.	Negative E_A	(2)																																
<table border="1"> <thead> <tr> <th>Gradient</th> <th>E_A/kJmol^{-1}</th> </tr> </thead> <tbody> <tr><td>-9600</td><td>79.8</td></tr> <tr><td>-9700</td><td>80.6</td></tr> <tr><td>-9800</td><td>81.4</td></tr> <tr><td>-9900</td><td>82.3</td></tr> <tr><td>-10000</td><td>83.1</td></tr> <tr><td>-10100</td><td>83.9</td></tr> <tr><td>-10200</td><td>84.8</td></tr> <tr><td>-10300</td><td>85.6</td></tr> <tr><td>-10400</td><td>86.4</td></tr> <tr><td>-10500</td><td>87.3</td></tr> <tr><td>-10600</td><td>88.1</td></tr> <tr><td>-10700</td><td>88.9</td></tr> <tr><td>-10800</td><td>89.7</td></tr> <tr><td>-10900</td><td>90.6</td></tr> <tr><td>-11000</td><td>91.4</td></tr> </tbody> </table>				Gradient	E_A/kJmol^{-1}	-9600	79.8	-9700	80.6	-9800	81.4	-9900	82.3	-10000	83.1	-10100	83.9	-10200	84.8	-10300	85.6	-10400	86.4	-10500	87.3	-10600	88.1	-10700	88.9	-10800	89.7	-10900	90.6	-11000	91.4
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Total for Question 3 = 15 Marks

Question Number	Acceptable Answer	Reject	Mark
4(a)(i)	Any three from: Shake/mix. (1) Release pressure/open stopper (from time to time). (1) Remove lower/dichloromethane layer by opening tap/using teat pipette. OR Decant the top layer/remove top layer with teat pipette. To score this mark it must be clear that the bottom layer is the layer required. (1) Repeat extraction with additional solvent. (1)	Just 'add the dichloromethane' Just 'separate the liquids'	(3)

Question Number	Acceptable Answer	Reject	Mark
4(a)(ii)	Add named drying agent (anhydrous) calcium chloride/magnesium sulfate/sodium sulphate. (1) ALLOW silica gel. IGNORE desiccators. (Allow to stand) decant/filter (to separate drying agent) (1) Both marks are stand alone.	Sulfuric acid KOH NaOH Heat with drying Agent Dry with filter paper	(2)

Question Number	Acceptable Answer	Mark
4(b)(i)	Carry out in fume cupboard/hood chamber/well-ventilated lab. (1) IGNORE gas/face masks. Wear (protective) gloves. (1) IGNORE lab coat and eye protection.	(2)

Question Number	Acceptable Answer	Reject	Mark
4(b)(ii)	Distillation/evaporate under reduced pressure/rotary evaporation. ALLOW fractional distillation. IGNORE recrystallisation.	Just evaporate	(1)

Question Number	Acceptable Answer	Reject	Mark
4(c)	CO ₂ is less harmful/not harmful/ less hazardous/not hazardous/ less irritant/not irritant/ non-flammable/ non-toxic/evaporates easily/easily removed. IGNORE comments regarding ozone layer or global warming.	Just CO ₂ safer/less risky	(1)

Question Number	Acceptable Answer	Reject	Mark
4(d)	85mg = 0.085g (1) % caffeine = $0.085/25 \times 100 = 0.34\%$ (1) ALLOW TE on incorrect mass. Correct answer alone scores both marks. IGNORE significant figures except 1 mark.	% caffeine > 100%	(2)

Question Number	Acceptable Answer	Reject	Mark
4(e)	Recrystallisation ALLOW column chromatography. ALLOW sublimation.	Distillation	(1)

Total for Question 4 = 12 marks

Total for Paper = 50 marks