



# Mark Scheme (Results)

Summer 2022

Pearson Edexcel International Advanced  
Level in Chemistry (WCH16)  
Paper 01: Practical Skills in Chemistry II

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## 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.

## Using the Mark Scheme

Examiners should look for qualities to reward rather than faults to penalise. This does NOT mean giving credit for incorrect or inadequate answers, but it does mean allowing 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 be worthy of credit.

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.

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) 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. Make sure that the answer makes sense. 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	Answer	Additional Guidance	Mark
1(a)(i)	<p>An answer that makes reference to the following points:</p> <p>copper(II) chloride / <math>\text{CuCl}_2</math> (2)</p>	<p>copper(II) / <math>\text{Cu}^{2+}</math> with incorrect anion scores 1</p> <p>chloride / <math>\text{Cl}^-</math> with incorrect cation scores 1</p> <p>copper chloride or <math>\text{CuCl}</math> scores one mark</p> <p>If name and formula are stated they must both be correct</p>	(2)

Question Number	Answer	Additional Guidance	Mark
1(a)(ii)	<p>An answer that makes reference to the following points:</p> <p>Either</p> <ul style="list-style-type: none"> <li>add dilute /aqueous ammonia (solution)/<math>\text{NH}_3(\text{aq})</math> (1)</li> <li>precipitate dissolves/disappears/forms a colourless solution/soluble (1)</li> </ul> <p>Or</p> <ul style="list-style-type: none"> <li>add <b>concentrated</b> sulfuric acid (1)</li> <li>misty / steamy / white fumes (1)</li> </ul>	<p>Ignore add concentrated ammonia/just <math>\text{NH}_3</math></p> <p>M2 depends on addition of ammonia(dil/conc)</p> <p>Ignore just sulfuric acid/<math>\text{H}_2\text{SO}_4</math></p> <p>M2 depends on addition of sulfuric acid</p> <p>Do not award white smoke (unless tested with ammonia)</p>	(2)

Question Number	Answer	Additional Guidance	Mark
1(b)(i)	An answer that makes reference to the following point: <ul style="list-style-type: none"> <li>ammonia (gas) / <math>\text{NH}_3(\text{g})</math></li> </ul>	Do not award $\text{NH}_4^+$	(1)

Question Number	Answer	Additional Guidance	Mark
1(b)(ii)	An answer that makes reference to the following points: <ul style="list-style-type: none"> <li>identification of cation (1)</li> <li>identification of anion (1)</li> </ul>	Accept cation/anion in any order $\text{NH}_4^+$ $\text{Cr}_2\text{O}_7^{2-}$ Ignore $\text{CrO}_4^{2-}$ Allow $(\text{NH}_4)_2\text{Cr}_2\text{O}_7$ scores (2) $\text{NH}_4\text{Cr}_2\text{O}_7$ scores (1) Allow ammonium dichromate((VI)) scores (1)	(2)

(Total for Question 1 = 7 marks)

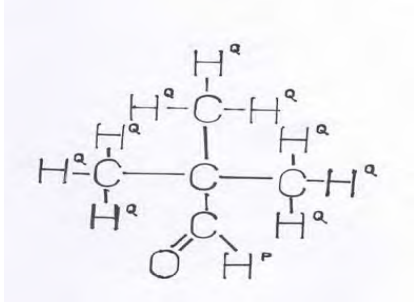
Question Number	Answer				Additional Guidance	Mark
2(a)(i)	An answer that makes reference to the following points:				Allow: no (observable) change/no ppt/remains the same for no reaction Any recognisable spelling of precipitate Penalise just no result/no observation/none/nothing once only  2/3 correct scores 1 4/5 correct scores 2 6 correct scores 3	(3)
		2,4-DNPH	Fehling's/Benedicts	I <sub>2</sub> /NaOH		
	C		no reaction solution (stays) blue	(pale) yellow ppt / antiseptic smell	(1)	
	D	no reaction/ solution (remains) orange/yellow	no reaction/ remains blue		(1)	
	E		(brick) red ppt/solid	no reaction remains colourless (unless ethanal)	(1)	

Question Number	Answer	Additional Guidance	Mark
2(a)(ii)	An answer that makes reference to the following point: <ul style="list-style-type: none"> <li>iodoform / triiodomethane / CHI<sub>3</sub></li> </ul>	ACCEPT HClI <sub>3</sub> , ClI <sub>3</sub> H Do not award CH <sub>3</sub> I, ClI <sub>3</sub> , iodomethane If name and formula are given, both must be correct	(1)

Question Number	Answer	Additional Guidance	Mark
2(b)(i)	<p>A description that makes reference to the following points:</p> <ul style="list-style-type: none"> <li>dissolve the solid/ppt in the minimum amount of warm/hot solvent/to produce a saturated solution (1)</li> <li>filter (hot) solution <b>and</b> cool/leave (so that crystals/solids form/crystallise) (1)</li> <li>filter the crystals (under reduced pressure) <b>and</b> wash (with cold solvent) (1)</li> <li>dry crystals using filter paper / oven / desiccator (1)</li> </ul>	<p>Marks are independent Allow references to named solvents e.g. ethanol, water</p> <p>Allow addition of solvent to solid <b>and</b> warm/heat</p> <p>Allow hot filter funnel or reduced pressure In M1 and M2 “hot/warm” must be mentioned once Do not award heat/evaporate solvent</p> <p>Allow: dry in a warm place Do not award heat/evaporate solvent unless M2 already lost for similar mistake Do not award use of drying agent except in a desiccator</p> <p>Ignore explanations of each step</p>	(4)



Question Number	Answer	Additional Guidance	Mark
2(b)(ii)	<p>An explanation that makes reference to two of the following points:</p> <ul style="list-style-type: none"> <li>identifies <b>C</b> is pentan-2-one (1)</li> <li>correct reason linked to information and data in Tables 1 and/or 2 (1)</li> </ul> <p>M2 depends on M1</p>	<p>Examples of reasons:</p> <ul style="list-style-type: none"> <li>it must have a COCH<sub>3</sub> group/positive iodoform</li> <li>(it cannot be 2-ethylbutanal/3-methyl butanal) because the measured melting temperature shouldn't be above the actual melting temperature/it must be a ketone/cannot be an alkanal</li> <li>it must be a non-cyclic ketone</li> <li>the(measured) melting temperature is closest ketone to the (actual) melting temperature</li> </ul>	(2)

Question Number	Answer	Additional Guidance	Mark
2(c)	<p>An answer that makes reference to the following points:</p> <ul style="list-style-type: none"> <li>correct formula for 2,2 dimethyl propanal (1)</li> <li>proton environments clearly labelled (1)</li> </ul> <p>M2 dependent on correct M1</p>	 <p>M1 Allow -CH<sub>3</sub> but not COH/CHO  M2 Allow proton environments for Q protons shown on methyl groups  Do not award proton environment for P protons on C or O of aldehyde group</p>	(2)

(Total for Question 2 = 12 marks)

Question Number	Answer	Additional Guidance	Mark
3(a)(i)	<p>An answer that makes reference to the following points:</p> <ul style="list-style-type: none"> <li>(concentrated) nitric acid is corrosive <b>and</b> wear/use gloves</li> <li>nitrogen (di)oxide/NO<sub>2</sub> (gas) is toxic/corrosive <b>and</b> carry out experiment in a fume cupboard</li> </ul>	<p>Ignore irritant/harmful Do not award any other reagent e.g. sodium thiosulfate, iodine, brass</p> <p>Allow burns/blisters skin</p> <p>(1) Ignore toxic Ignore avoid skin contact Do not award nitric acid is flammable</p> <p>(1) Allow well ventilated room Ignore reference to flames/bunsens/gas mask/face mask</p>	(2)

Question Number	Answer	Additional Guidance	Mark
3(a)(ii)	<ul style="list-style-type: none"> <li>green solution formed</li> <li>(reddish/yellow) brown fumes formed</li> </ul>	<p>(1) Allow any shade of green/blue solution formed Ignore metal would dissolve</p> <p>(1) Ignore just effervescence</p>	(2)

Question Number	Answer	Additional Guidance	Mark
3(a)(iii)	<p>An answer that makes reference to the following point:</p> <ul style="list-style-type: none"> <li>to prevent too much effervescence/fizzing / the reaction mixture spilling over /CO<sub>2</sub> being formed too quickly</li> </ul>	<p>Allow the reaction is vigorous/ to slow down the reaction</p> <p>Ignore exothermic (reaction)/water might boil/ splashing not linked to gas given off Do not award to stop the reaction</p>	(1)

Question Number	Answer	Additional Guidance	Mark
3(a)(iv)	<p>A description that makes reference to three of the following points:</p> <ul style="list-style-type: none"> <li>(transfer contents of beaker to) and washings to a <b>volumetric</b> flask (1)</li> <li>make up to the mark with (distilled/deionised) water (1)</li> <li>shake / mix (1)</li> </ul>	<p>If beaker/measuring cylinder used penalise in M1 only If incorrect solvent e.g. ethanol/ethanoic acid used penalise in M2 only</p> <p>Allow standard / graduated flask</p> <p>Allow any indication of mixing e.g. inverting/swirling</p>	(3)

Question Number	Answer	Additional Guidance	Mark
3(b)(i)	<ul style="list-style-type: none"> <li>adding electrode potentials (1)</li> <li>cell potential is negative/<math>&lt;0</math> (so not feasible) (1)</li> </ul>	<p>Example of calculation</p> $E_{\text{cell}} = +0.15 - 0.54 = -0.39(\text{V})$ <p>Incorrect negative <math>E_{\text{cell}}</math> value can score M2</p>	(2)

Question Number	Answer	Additional Guidance	Mark
3(b)(ii)	<ul style="list-style-type: none"> <li>the copper (I) iodide/<math>\text{Cu}^+</math> precipitates / is removed from the equilibrium / the concentration of copper(I) in solution is very low (1)</li> <li>the equilibrium position moves to the right-hand side (1)</li> </ul>	<p>Accept the actual electrode potential (for <math>\text{Cu}^{2+}/\text{Cu}^+</math>) is higher/more positive than the standard electrode potential</p> <p>Ignore reference to activation energy / rate of reaction/non-standard temperature/pressure</p> <p>Allow 1 mark for concentrations are non-standard</p> <p>If value in (i) for <math>E_{\text{cell}}</math> is positive then allow 1 mark in (ii) for reference to a spontaneous reaction for a positive <math>E_{\text{cell}}</math></p>	(2)

Question Number	Answer	Additional Guidance	Mark
3(c)(i)	<ul style="list-style-type: none"> <li>an (insoluble) complex/solid will be formed</li> </ul>	Allow iodine binds to the starch and makes the end point more difficult to see	(1)

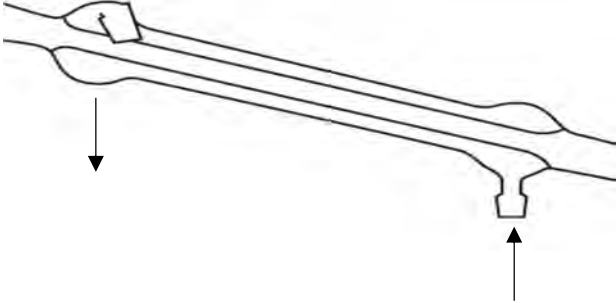
Question Number	Answer	Additional Guidance	Mark
3(c)(ii)	<ul style="list-style-type: none"> <li>blue-black to colourless (at the end point)</li> </ul>	Allow blue or black Ignore clear	(1)

Question Number	Answer	Additional Guidance	Mark
3(c)(iii)	<ul style="list-style-type: none"> <li>calculation of titre and mean of concordant results</li> </ul>	Example of calculation (27.05;26.65) 26.45 $(26.65 + 26.45) \div 2 = 26.55(\text{cm}^3)$	(1)

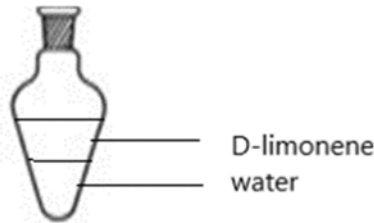
Question Number	Answer	Additional Guidance	Mark
3(c)(iv)	<ul style="list-style-type: none"> <li>calculation of moles thiosulfate in titre</li> <li>calculation of mass of copper in 25cm<sup>3</sup> as stoichiometry of Cu: thiosulfate is 1:1</li> <li>calculation of % of copper by mass in sample</li> </ul>	<p>Example of calculation</p> <p>(1) <math>\frac{26.55}{1000} \times 0.095 = 2.52225 \times 10^{-3} / 0.00252225 \text{ (mol)}</math> TE on (c)(iii)</p> <p>(1) <math>2.52(225) \times 10^{-3} \times 63.5 = 0.160163 \text{ (g)}</math></p> <p>(1) <math>\frac{0.160163}{2.53} \times 10 \times 100 = 63.305 / 63.31 / 63.3 / 63 \%</math> TE on M2 unless greater than 100 % Ignore SF except 1 SF Correct answer with some working scores (3)</p>	(3)

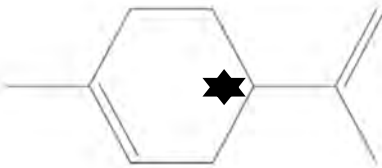
Question Number	Answer	Additional Guidance	Mark
3(c)(v)	<p>An explanation that makes reference to two of the following points:</p> <ul style="list-style-type: none"> <li>because more iodine will be produced</li> <li>more thiosulfate will be needed (so the titre will be greater) <b>and</b> the percentage of copper will be greater</li> </ul>		(2)

(Total for Question 3 = 20 marks)

Question Number	Answer	Additional Guidance	Mark
4(a)(i)	<p>An answer that makes reference to the following point:</p> <ul style="list-style-type: none"> <li>arrows/labels showing water going in at the bottom and out at the top</li> </ul>	 <p>Allow single arrow on condenser going from right to left</p>	(1)

Question Number	Answer	Additional Guidance	Mark
4(a)(ii)	<p>An answer that makes reference to the following point:</p> <ul style="list-style-type: none"> <li>limonene is degraded / decomposed / broken down by high temperatures</li> </ul>	(Limonene) distils at a lower temperature than its boiling temperature.	(1)

Question Number	Answer	Additional Guidance	Mark
4(a)(iii)	<ul style="list-style-type: none"> <li>a diagram of a (pear-shaped) flask containing two layers with (D-)limonene being labelled the upper layer</li> </ul>		(1)

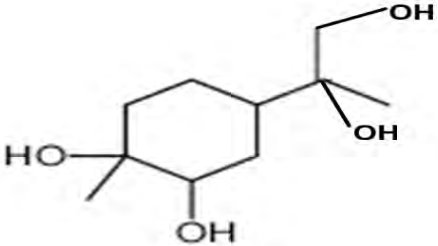
Question Number	Answer	Additional Guidance	Mark
4(b)(i)	<ul style="list-style-type: none"> <li>identification of the correct chiral carbon</li> </ul>	 <p>Allow any indication of chiral carbon</p>	(1)

Question Number	Answer	Additional Guidance	Mark
4(b)(ii)	<p>An answer that makes reference to the following points:</p> <ul style="list-style-type: none"> <li>polarimeter/ two polarised filters (1)</li> <li>rotates the plane of plane-polarised light (1)</li> </ul>	<p>Allow polariser(s)</p> <p>Allow rotates plane-polarised light</p> <p>Ignore angles of rotation</p> <p>Do not award rotation of the molecule</p>	(2)



Question Number	Answer	Additional Guidance	Mark
4(b)(iii)	<ul style="list-style-type: none"> <li>calculation of mass of limonene</li> <li>calculation of molar mass of limonene</li> <li>calculation of moles of limonene</li> </ul>	<p>Example of calculation</p> <p><math>1.2 \times 0.851 = 1.0212 \text{ (g)}</math>  <b>Accept</b> <math>0.851 \div 1.20 = 0.70916666 \text{ (g)}</math></p> <p><math>10 \times 12 + 16 = 136</math></p> <p><math>1.0212 / 136 = 7.5088 \times 10^{-3} / 0.0075088 \text{ (mol)}</math>  <math>= 7.5 \times 10^{-3} \text{ (mol)}</math>  <b>TE from "Accept"</b>  <math>0.70917 / 136 = 5.21446 \times 10^{-3} / 0.0052145 \text{ (mol)}</math>  <math>5.2145 \times 10^{-3} \text{ (mol)}</math></p> <p>Both answers score all three marks with some working  TE from incorrect mass, molar mass and density  Ignore SF</p>	(3)

Question Number	Answer	Additional Guidance	Mark
4(c)(i)	<p>An answer that makes reference to the following point:</p> <ul style="list-style-type: none"> <li>purple to colourless</li> </ul>	<p>Allow pink to colourless  Allow purple to pink because in part (ii) excess is being used  Do not award violet</p>	(1)

Question Number	Answer	Additional Guidance	Mark
4(c)(ii)	<p>An answer that makes reference to the following point:</p> <ul style="list-style-type: none"> <li>both double bonds replaced by two OH groups</li> </ul>	 <p>Allow drawn structures with one or both C=C double bonds broken Ignore bond angles/lengths/connectivity of -OH</p>	(1)

(Total for Question 4 = 11 marks)

**TOTAL FOR PAPER = 50 MARKS**

