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Mark Scheme (Results)

October 2020

Pearson International Advanced Level
In Chemistry (WCH06)
Paper 1: Chemistry Laboratory Skills 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.

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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.

Quality of Written Communication
Questions which involve the writing of continuous prose will expect candidates to:
- write legibly, with accurate use of spelling, grammar and punctuation in order to make the meaning clear
- select and use a form and style of writing appropriate to purpose and to complex subject matter
- organise information clearly and coherently, using specialist vocabulary when appropriate.

Full marks will be awarded if the candidate has demonstrated the above abilities.
Questions where QWC is likely to be particularly important are indicated (QWC) in the mark scheme, but this does not preclude others.

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Question Number	Correct Answer	Reject	Mark
1(a)(i)	Cu^{2+}/ $Cu(H_2O)_6^{2+}$ ALLOW Cu^{+2} IGNORE name	Co^{2+}	1

Question Number	Correct Answer	Reject	Mark
1(a)(ii)	pale blue precipitate (1) (in excess) deep blue solution (1) ALLOW royal blue any wording that indicates the solution is a darker blue than the precipitate eg blue and dark blue Two correct colours without stating ppt and solution scores (1) ppt and solution OR precipitate dissolves without colours scores (1) IGNORE formulae	Lavender blue	2

Question Number	Correct Answer	Reject	Mark
1(a)(iii)	yellow ALLOW yellow-green / green / olive green (solution) (1) $CuCl_4^{2-}$ / $[CuCl_4]^{2-}$ ALLOW $[CuCl_4]^{-2}$ (1)	Cu_2Cl_4	2

Question Number	Correct Answer	Reject	Mark
1(a)(iv)	brown solution: I_3^- / I_2 / iodine ALLOW KI_3 (1) white solid: CuI / copper(I) iodide ALLOW Copper iodide **and** CuI Cu_2I_2 (1)	Just "Copper iodide"	2

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Question Number	Correct Answer	Reject	Mark
1(b)(i)	Benedict's (solution) / Fehling's (solution)	Tollens' reagent	1

Question Number	Correct Answer	Reject	Mark
1(b)(ii)	Cu_2O IGNORE name		1

Question Number	Correct Answer	Reject	Mark
1(b)(iii)	(blue solution forms) a red-brown **precipitate** ALLOW red precipitate brick-red precipitate "solid" for precipitate	Brown precipitate	1

(Total for Question 1 = 10 marks)

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Question Number	Correct Answer	Reject	Mark
2(a)	**Test:** (add solution of) sodium carbonate / sodium hydrogencarbonate / Na_2CO_3 / $NaHCO_3$ ALLOW addition of other carbonates / potassium hydrogencarbonate / $KHCO_3$ / magnesium / Mg / sodium bicarbonate If a name **and** a formula are given both must be correct. (1) **Result:** effervescence / fizzing / bubbles (of colourless gas) IGNORE gas / carbon dioxide evolved (with carbonate or hydrogencarbonate) / hydrogen evolved (with reactive metal)/ testing with lime water M2 depends on a correct reagent in M1 or near miss (1) ALLOW for both marks warm with a named alcohol **and** acid catalyst (1) production of sweet/ pleasant smell (1)	sodium / Na /NaOH/ phosphorus(V) chloride / PCl_5/ addition of $LiAlH_4$	2

Question Number	Correct Answer	Reject	Mark
2(b)(i)	**A** contains OH (group(s))/ hydroxy(l) (group(s)) ALLOW **A** is / contains an alcohol	hydroxide carboxylic acid / COOH	1

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Question Number	Correct Answer	Reject	Mark
2(b)(ii)	Observation: yellow / orange / orange-yellow / red **and** precipitate / solid (1) Deduction: **A** contains a carbonyl group / a C=O group / has an aldehyde **or** ketone functional group (1)	Just **A** is an aldehyde just **A** is a ketone	2

Question Number	Correct Answer	Reject	Mark
2(b)(iii)	**A** contains a ketone (functional group) OR **A** is not an aldehyde The OR mark depends on a ketone being mentioned in (ii)		1

Question Number	Correct Answer	Reject	Mark
2(b)(iv)	**A** contains CH_3CO / methyl ketone OR **A** contains $CH_3CH(OH)$ / methyl secondary alcohol OR The CO is next to/ adjacent to/ bonded to a methyl group	Just “contains a methyl group”	1

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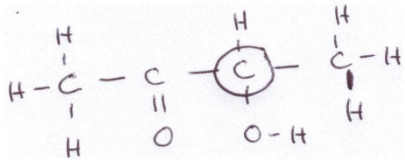
Question Number	Correct Answer	Reject	Mark
2(b)(v)	 ALLOW undisplayed bonds in O–H and CH_3 IGNORE Connectivity of OH (1) Chiral C circled (1) M2 is standalone for an isomer of butanoic acid with chiral centre Eg C2 in $CH_2OHCH(OH)CH=CH_2$ C2 in $CH_3CH(CHO)CH_2OH$	$CH_2OHCOCH_3$ An aldehyde An ester $CH_3CH_2COOCH_3$ Methyl propanoic acid	2

Question Number	Correct Answer	Reject	Mark
2(b)(vi)	there are 4 hydrogen/ proton/ H environments in the molecule		1

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<table>
<tr><th>Question Number</th><th>Correct Answer</th><th>Reject</th><th>Mark</th></tr>
<tr><td>2b(vii)</td><td>
<table>
<tr><th>singlets</th><th>doublets</th><th>triplets</th><th>quartets</th></tr>
<tr><td>2</td><td>1</td><td>0</td><td>1</td></tr>
</table>

All correct (3)
3 correct (2)
2 correct (1)

Allow TE for incorrect formula in (v) with 4 H environments: $CH_2OHCH_2COCH_3$
<table>
<tr><th>singlets</th><th>doublets</th><th>triplets</th><th>quartets</th></tr>
<tr><td>2</td><td>0</td><td>2</td><td>0</td></tr>
</table>

TE for molecules with fewer or more than 4 environments, or incorrect number of C
Max (2)

Eg $CH_3CH(CHO)CH_2OH$

(5 environments : 1,3,0,0 + a heptet))

CH_3COCH_2OH: 3,0,0,0

$(CH_3)_2CHCOOH$: 1,2,0) + a heptet</td><td></td><td>3</td></tr>
</table>

(Total for Question 2 = 13 marks)

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Question Number	Correct Answer	Reject	Mark
3(a)	$CH_3COOC_2H_5 + H_2O \rightarrow CH_3COOH + C_2H_5OH$ ALLOW reversible arrow IGNORE state symbols even if incorrect H^+ or HCl above arrow	Use of HCl in equation H_2O missing from equation Molecular formulae	1

Question Number	Correct Answer	Reject	Mark
3(b)	the acid is a catalyst IGNORE The acid is not used up in the reaction The acid is in excess	The acid does not affect the rate The acid does not take part in the reaction	1

Question Number	Correct Answer	Reject	Mark
3(c)	to stop / slow down / quench the reaction ALLOW To freeze the reaction IGNORE reaction is exothermic To remove heat To control temperature	To solidify the reaction To neutralise HCl	1

Question Number	Correct Answer	Reject	Mark
3(d)	colourless to (pale) pink	red / purple	1

Question Number	Correct Answer	Reject	Mark
3(e)(i)	Maximum number of moles / (total) amount of acid which forms ALLOW Maximum number of moles / amount of acid present after **complete** hydrolysis of the ester It shows whether all the ester has been hydrolysed	amount of alcohol produced just "to check reaction was complete" It shows that the reaction has reached equilibrium to find concordant values	1

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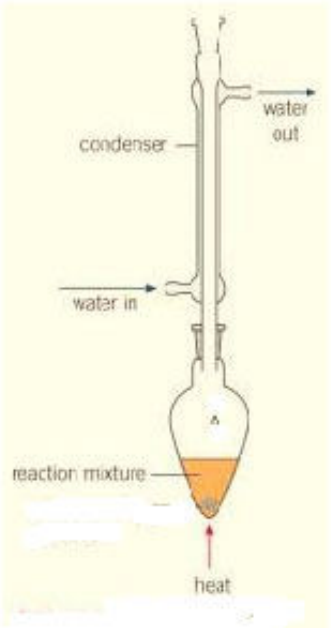
Question Number	Correct Answer	Reject	Mark
3(e)(ii)	 round-bottom / pear shaped flask **and** heat source (eg heating mantle / electric heater / water bath) ALLOW arrow for heat IGNORE absence of anti-bumping granules (1) vertical reflux condenser, drawn **or** labelled with water in at bottom, out at top and a joint with the flask (1) apparatus with no gaps at joints and open at top IGNORE thermometer if apparatus is not sealed by it Clamps (1) Completely correct distillation max (2)	Conical flask gaps between neck of flask and condenser condenser sealed at top	3

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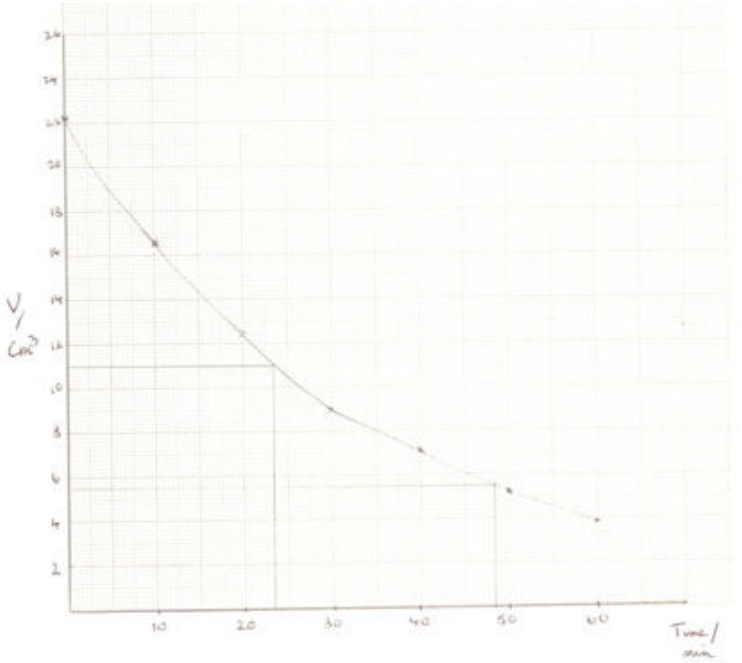
Question Number	Correct Answer	Reject	Mark
3(f)(i)	 axes labelled with quantity **and** units (1) points correctly plotted using at least half the graph paper in both directions and a smooth curve through points (1)	Time on vertical axis	2

Question Number	Correct Answer	Reject	Mark
3(f)(ii)	two half-lives in range 22-26 (minutes) IGNORE seconds for minutes (1) first order (1) Note: if second half-life is 2 x first, then M2 can be awarded.		2

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Question Number	Correct Answer	Reject	Mark
3(g)(i)	Mass ethyl ethanoate = 10 x 0.900 = 9.00 g Mol = 9.00 / 88.1 = 1.021566 x 10^{-1} / 0.102 (mol) IGNORE SF except 1 SF ALLOW 0.10/ 0.1022	 0.1	1

Question Number	Correct Answer	Reject	Mark
3(g)(ii)	the water (present in the HCl solution) is in (large) excess. ALLOW Concentration of water is constant Number of moles of water is constant IGNORE Water is not in the rate determining step Water does not affect the rate Water is in a different state	Just "ester is limiting factor" Order wrt water is zero	1

Question Number	Correct Answer	Reject	Mark
3(h)	pH is not directly proportional to acid concentration ALLOW pH is not directly proportional to acid volume (1) Any one from so graph would not show change in ester concentration **OR** change in pH of the mixture would be small / narrow/ not drastic **OR** (change in pH) undetectable in presence of high [H^+] in hydrochloric acid (1) IGNORE Carboxylic acid is weak	 pH remains constant Change in pH cannot be measured accurately	2

(Total for Question 3 = 16 marks)

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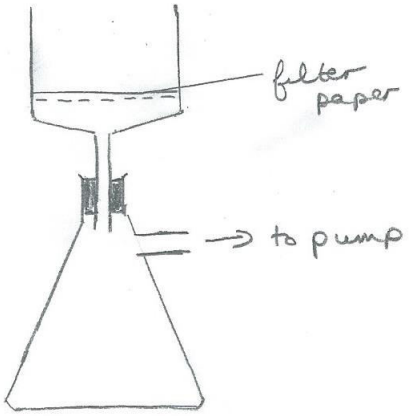
Question Number	Correct Answer	Reject	Mark
4(a)	oxidant/ oxidising (agent) (1) corrosive **and** poisonous/ toxic (1)	Easily oxidised Flammable Combustible Harmful Hazardous	2

Question Number	Acceptable Answers	Reject	Mark
4(b)	 Funnel with perforated base ALLOW Funnel labelled as Buchner funnel even if perforated base not clear (1) Filter paper **and** flask with side arm (Buchner flask) (1) (Reduced pressure achieved by) connection to suction pump/ vacuum pump / (water) aspirator ALLOW To pump / to vacuum (1)	Gap between funnel and flask	3

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Question Number	Correct Answer	Reject	Mark
4(c)	$Cr(OH)_3$/ chromium (III) hydroxide If name and formula are given both must be correct ALLOW $Cr(OH)_3(H_2O)_3$ (1) Green ALLOW grey green Mark does not depend on M1 being correct (1)	Chromium oxide	2

Question Number	Correct Answer	Reject	Mark
4(d)	Full range/ Universal Indicator/ UI paper **and** Goes red Use of pH meter **and** pH ≤ 3	Test with sodium carbonate/ sodium hydrogencarbonate Blue litmus paper goes red	1

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<table>
<tr><th>Question Number</th><th>Correct Answer</th><th>Reject</th><th>Mark</th></tr>
<tr><td>4(e)</td><td>10.0 g benzocaine = 10.0/165 mol = 6.0606 x 10^{-2} / 0.0606 mol (1)

Mols required = (6.0606 x 10^{-2} x (100/70) x (100/70))
= 0.123686 (mol) (1)

Mass 4-nitrobenzoic acid required = (0.123686 x 167)

= 20.656 (g) (1)

Ignore SF except 1 SF

ALLOW
Alternative methods

Correct answer with no working scores 3 marks.

Other possible answers:

Use of 0.06 gives 0.12245 for M2

Use of 0.06 gives final answer 20.449
Scores (2) out of 3

<table><tr><td>14.457</td><td>Use of 100/70 once = 1 error</td><td>2</td></tr><tr><td>7.084</td><td>Use of 70/100 once = 2 errors</td><td>1</td></tr><tr><td>4.959</td><td>Use of 70/100 twice = 1 error</td><td>2</td></tr></table></td><td>0.06</td><td>3</td></tr>
</table>

(Total for Question 4 = 11 marks)

Total for paper = 50 marks

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