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Mark Scheme (Results)

January 2017

Pearson Edexcel
International Advanced Subsidiary Level
in Chemistry (WCH06)
Paper 01 Chemistry Laboratory Skills II

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Publications Code WCH06_01_MS_1701*

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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.
- Mark schemes will indicate within the table where, and which strands of QWC, 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 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.

Question Number	Acceptable Answer	Reject	Mark
1(a)	d block (elements) OR transition metals / elements ALLOW D block		1

Question Number	Acceptable Answer	Reject	Mark
1(b)	Fe ²⁺ ALLOW Ni ²⁺ / Cr ³⁺ IGNORE Water ligands in formulae	Names Fe ³⁺	1

Question Number	Acceptable Answer	Reject	Mark
1(c)	green ppt: iron(II)hydroxide / Fe(OH) ₂ (1) TE only on cations allowed in 1(b) brown solid: iron(III)hydroxide / Fe(OH) ₃ (1) IGNORE Water ligands in formulae No TE on incorrect ions or incorrect green ppt	Iron(II) oxide / FeO Iron(III) oxide / Fe ₂ O ₃	2

Question Number	Acceptable Answer	Reject	Mark
1(d)	Test: (damp) red litmus (paper) OR (damp) universal indicator /U.I. (paper) (1) Result: turns blue (1) Result mark dependent on correct indicator Just 'litmus' and 'red turns blue' scores both marks OR	Just 'litmus'	3
	Test: hydrogen chloride / HCl / expose to vapour from (conc) hydrochloric acid (1) Result: white smoke (1) IGNORE Formula even if incorrect Result mark dependent on correct reagent or 'add HCl(aq)' Inference: NH_4^+ (1)	Add HCl(aq) Fumes / cloud NH_3	

Question Number	Acceptable Answer	Reject	Mark
1(e)	TEST reagents (in either order) Barium chloride (solution) / $\text{BaCl}_2(\text{aq})$ OR Barium nitrate (solution) / $\text{Ba}(\text{NO}_3)_2(\text{aq})$ (1) (dilute) hydrochloric acid / $\text{HCl}(\text{aq})$ ALLOW HCl OR (dilute) nitric acid / $\text{HNO}_3(\text{aq})$ (1) OBSERVATION White precipitate / ppt / ppte ALLOW White solid / white crystals (1) Acid and observation marks are dependent on a soluble barium compound. If a correct barium compound is given, the observation mark may be awarded If there is a formula error for the barium compound the other marks may be awarded		3

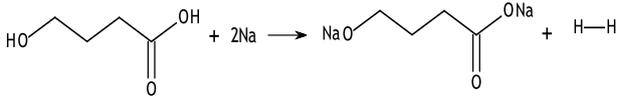
Question Number	Acceptable Answer	Reject	Mark
1(f)	<p>$\text{Fe}(\text{NH}_4)_2(\text{SO}_4)_2$ OR $\text{FeSO}_4 \cdot (\text{NH}_4)_2\text{SO}_4$</p> <p>ALLOW ions in any order any ratio of Fe^{2+} to NH_4^+ with correctly balanced formula and no nett charge</p> <p>TE on Cr^{3+} giving $\text{Cr}(\text{NH}_4)(\text{SO}_4)_2$ OR on Ni^{2+} giving $\text{Ni}(\text{NH}_4)_2(\text{SO}_4)_2$</p> <p>IGNORE Water of crystallisation</p>		1

(Total for Question 1 = 11 marks)

Question Number	Acceptable Answer	Reject	Mark
2(a)(i)	<p>The amount of 4-hydroxybutanoic acid used is small OR 4-hydroxybutanoic acid is not volatile / has a high boiling temperature / flash point IGNORE References to melting point / low flammability</p>		1

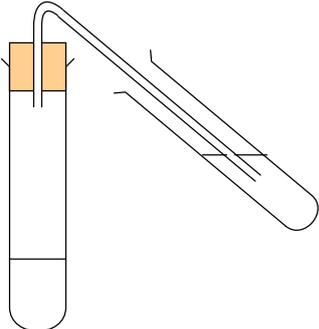
Question Number	Acceptable Answer	Reject	Mark
2(a)(ii)	<p>So the 4-hydroxybutanoic acid does not boil / evaporate / vaporise OR To reduce the risk of sodium vapour forming OR At high temperature the sodium might ignite OR The hydrogen gas might ignite / explode</p> <p>IGNORE to keep the temperature low / $<100^\circ\text{C}$ / better controlled</p> <p>4-hydroxybutanoic acid has a low boiling point The reaction is too vigorous</p>	<p>4-hydroxybutanoic acid does not melt / turn into a liquid</p> <p>4-hydroxybutanoic acid is flammable</p>	1

Question Number	Acceptable Answer	Reject	Mark
2(a)(iii)	Effervescence / bubbling / fizzing ALLOW sodium dissolves / disappears / melts / reduces in size IGNORE Gas / hydrogen evolves / precipitate forms / steam / fumes / heat produced		1

Question Number	Acceptable Answer	Reject	Mark
2(a)(iv)	 OR O ⁻ Na ⁺ and H ₂ Skeletal structure of product (1) Balanced equation OR multiples (1) IGNORE attachment of OH unless written C-H-O Balanced equation mark may be awarded with any representation of organic reactant and product showing the correct numbers of atoms. If only one H replaced, max 1 for the skeletal formula and balanced equation	O-Na	2

Question Number	Acceptable Answer	Reject	Mark
2(b)(i)	Carbon dioxide IGNORE CO ₂		1

Question Number	Acceptable Answer	Reject	Mark
2(b)(ii)	(Bubble / pass the gas through) lime water OR calcium hydroxide solution / $\text{Ca(OH)}_2(\text{aq})$ (1) (Clear, colourless lime water) turns cloudy / milky / forms a white precipitate (1)		2

Question Number	Acceptable Answer	Reject	Mark
2(b)(iii)	 <p>Reaction test tube, closed, with contents and delivery tube clear of reaction mixture ALLOW Full labelling for the contents (1) Delivery tube immersed in lime water in open test tube (1) If reaction tube is not shown, MP2 may be awarded for container and delivery tube immersed in limewater IGNORE horizontal test tubes Do not penalise inaccurate drawing such as blocked tubes or gaps</p>		2

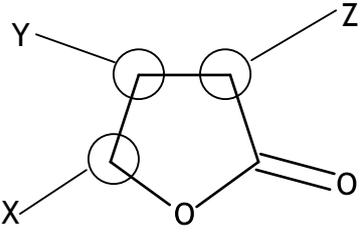
Question Number	Acceptable Answer	Reject	Mark
2(c)(i)	Reaction with sodium hydrogencarbonate / in 2(b) shows that the (carboxylic) acid group is present (1) Reaction with sodium / in 2(a) shows that an OH group is present. As it is given by both groups, it does not show that an alcohol (group) is present. (1)		2

Question Number	Acceptable Answer	Reject	Mark
2(c)(ii)	<p>Alcohol group has an (O-H) absorption in the range 3750-3200 (cm^{-1})</p> <p>ALLOW Hydroxy / OH group / OH bond has an absorption in the range 3750-3200 (cm^{-1}) (1)</p> <p>Carboxylic acid group has an (O-H) absorption in the range 3300-2500 (cm^{-1}) OR Carboxylic acid group has an (C=O) absorption in the range 1725-1700 (cm^{-1}) ALLOW C=O has an absorption in the range 1725-1700 (cm^{-1}) (1)</p> <p>Penalise the use of single wavenumbers or incomplete ranges once only</p>	<p>Answers that do not quote data</p> <p>Answers that just list data</p>	2

Question Number	Acceptable Answer	Reject	Mark
2(c)(iii)	<p>The two isomers will have (the same functional group absorptions but) different absorption patterns in the fingerprint region. (So the infrared spectra will be different.)</p> <p>ALLOW any indication that the fingerprint region could be used to distinguish the compounds even when the answer is 'no but...'</p>		1

Question Number	Acceptable Answer	Reject	Mark
2(d)(i)	Esterification / ester formation	Condensation Elimination	1

Question Number	Acceptable Answer	Reject	Mark
2(d)(ii)	<p>(concentrated) sulfuric acid / H_2SO_4</p> <p>ALLOW Name or formula of any strong acid Dilute strong acids</p>	H^+ / H_3O^+	1

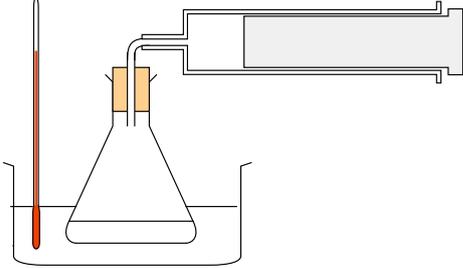
Question Number	Acceptable Answer	Reject	Mark												
2(d)(iii)	<p>If carbonyl carbon ringed then answer scores zero</p>  <p>Labelling in any order (1)</p> <table border="1" data-bbox="411 696 943 1055"> <thead> <tr> <th>Proton environment</th> <th>Relative Peak Height</th> <th>Splitting pattern</th> </tr> </thead> <tbody> <tr> <td>X</td> <td>1</td> <td>3</td> </tr> <tr> <td>Y</td> <td>1</td> <td>5</td> </tr> <tr> <td>Z</td> <td>1</td> <td>3</td> </tr> </tbody> </table> <p>(1) (1)</p> <p>All three peak heights scores 1 mark All three splitting patterns scores 1 mark</p> <p>OR</p> <p>Any indication of equal peak heights (e.g. 2:2:2) Splitting indicated by words: triplet, quintet, triplet</p> <p>ALLOW</p> <p>Use of non-standard terms e.g. '3 splits', 'pentate' / 'pentet'</p>	Proton environment	Relative Peak Height	Splitting pattern	X	1	3	Y	1	5	Z	1	3		3
Proton environment	Relative Peak Height	Splitting pattern													
X	1	3													
Y	1	5													
Z	1	3													

(Total for Question 2 = 20 marks)

Question Number	Acceptable Answer	Reject	Mark
3(a)(i)	Standalone marks sodium nitrite / sodium nitrate(III) / NaNO_2 OR potassium nitrite / potassium nitrate(III) / KNO_2 (1)	sodium nitrate potassium nitrate	2
	Hydrochloric acid / HCl(aq) ALLOW HCl OR Any strong acid by name or formula (1) IGNORE Concentrated / dilute		

Question Number	Acceptable Answer	Reject	Mark
3(a)(ii)	Using an ice-water / ice bath	Thermostatic bath	1

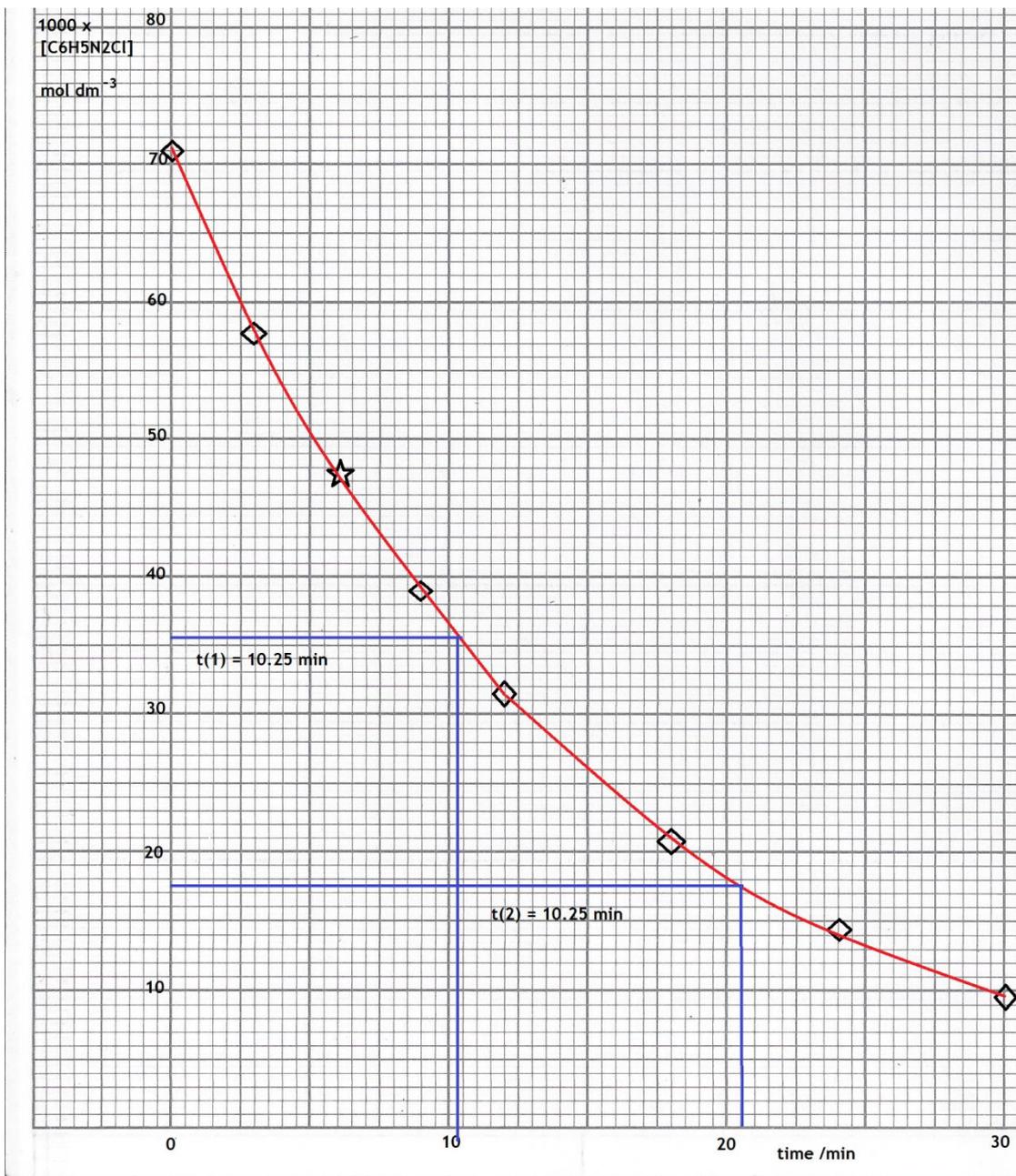
Question Number	Acceptable Answer	Reject	Mark
3(b)(i)	Reaction does not need to be quenched OR Timing of data points is (much) more accurate OR Small amounts of reaction mixture can be used ALLOW Reaction does not need to be stopped OR More data can be collected (so more accurate) OR Reaction continues in samples (before quenching) IGNORE References to speed of measurement time needed for the experiment Just 'experiment is more accurate'		1

Question Number	Acceptable Answer	Reject	Mark
3(b)(ii)	 <p>Sealed system and delivery tube starting above the reaction mixture (1)</p> <p>Water bath with thermometer</p> <p>ALLOW Thermometer in reaction mixture with water bath or some other heat source</p> <p>Partial immersion of vessel in water bath (1)</p> <p>Syringe</p> <p>ALLOW Collection over water in a graduated container (1)</p>		3

Question Number	Acceptable Answer	Reject	Mark
3(c)(i)	<p>Successive volume measurements are the same</p> <p>ALLOW No more gas is evolved</p> <p>IGNORE No more effervescence / fizzing / bubbles</p>	Heating to constant mass	1

Question Number	Acceptable Answer	Reject	Mark
3(c)(ii)	Fraction of N ₂ = 19.3/58.3 = 0.331 Fraction of benzenediazonium chloride remaining = 1 - 0.331 = 0.669 [C ₆ H ₅ N ₂ Cl] = 0.669 x 0.071 = 0.047496 / 0.047 (mol dm ⁻³) ALLOW 0.048 (mol dm ⁻³) Some indication of correct working needed IGNORE SF except 1 SF	Interpolation from the graph 47.5 (mol dm ⁻³) 2 x 0.0235 = 0.047	1

Question Number	Acceptable Answer	Reject	Mark
3(c)(iii)	See below for example Sensible choice scale (using at least 2/3 of both axes) and labelled axes with correct units (1) Points given in table correctly plotted ALLOW one error (1) (reasonably) smooth best fit line ALLOW 'point to point' line Line passing within 1 small square of points (1) IGNORE Any extension of the line beyond 30 min Axes wrong way round max 2 Non-linear scale scores 0/3		3



Question Number	Acceptable Answer	Reject	Mark
3c(iv)	$t_{1/2}(1) = 10.25 \text{ min}$ $t_{1/2}(2) = 10.25 \text{ min}$ ALLOW 9.50-11 min No TE on badly drawn line	No working	1

Question Number	Acceptable Answer	Reject	Mark
3c(v)	Because both values are the same / similar the reaction is first order (wrt benzenediazonium chloride) This mark may only be awarded if half lives in 3c(iv) are the same (± 1 min) half lives are given as (e.g.) 10.25 and 20.5 min	Just 'first order'	1

Question Number	Acceptable Answer	Reject	Mark
3d(i)	Wear gloves IGNORE Use of fume cupboard		1

Question Number	Acceptable Answer	Reject	Mark
3d(ii)	(Minimum amount of solvent) to minimise the amount of dye left in solution (when it recrystallises) OR To maximise the amount of dye that crystallises ALLOW To form a saturated solution (of dye) OR So the solution (of dye) is as concentrated as possible IGNORE references to Size of crystals Speed / ease of crystallisation Yield	to minimise the amount of dye left in the hot solution increases purity percentage error	1

Question Number	Acceptable Answer	Reject	Mark
3d(iii)	So that the dye cannot crystallise in / block the stem of the funnel ALLOW So that the product / dye will not remain in the stem IGNORE Reference to the solution / filtrate remaining in the stem Pre-heating of funnel Increases speed of filtration Increased yield	percentage error	1

Question Number	Acceptable Answer	Reject	Mark
3d(iv)	Soluble / dissolved impurities (1)	percentage error	2
	So that the filtered solid is dry / drier / removes more solvent		
	ALLOW So that filtration is fast (1)		
	IGNORE Purer product Increased yield		

(Total for Question 3 = 19 marks)

Total for Paper = 50 marks

