

Mark Scheme (Results)

January 2016

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

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Publications Code IA043137*

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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 OR Transition elements / metals / block ALLOW D block Transitional for transition element / metal		1

Question Number	Acceptable Answer	Reject	Mark
1 (b)	Cu ²⁺ / copper(II) OR Fe ³⁺ / iron(III) OR Cu ²⁺ /copper(II) and Fe ³⁺ / iron(III)	copper / Cu Fe ²⁺ / iron(II) iron / Fe	1

Question Number	Acceptable Answer	Reject	Mark
1 (c)	Cu ²⁺ / copper(II) ALLOW Cu(H ₂ O) ₆ ²⁺ / Cu(H ₂ O) ₄ ²⁺	Cu / copper	1

Question Number	Acceptable Answer	Reject	Mark
1 (d)	Chlorine / Cl ₂ (1) Chloride / Cl ⁻ (1)	Cl / chloride Cl / chlorine / Cl ₂	2

Question Number	Acceptable Answer	Reject	Mark
1 (e)	copper(I) chloride / CuCl (1) No TE on 1(c) oxidation / redox (reaction) (1) Standalone mark	Reduction / disproportionation	2

Question Number	Acceptable Answer	Reject	Mark
1 (f)	<p>(To a solution of A) add (dilute aqueous) ammonia / NH₃(aq) (until no further change) (1)</p> <p>(pale blue precipitate dissolves) to form a dark blue solution ALLOW (pale) blue precipitate /solid /crystals (1)</p> <p>OR</p> <p>Flame test (1) Blue-green / blue /green colour (1)</p> <p>OR</p> <p>Add potassium iodide / KI (1) Turns brown (1)</p> <p>ALLOW</p> <p>Add sodium hydroxide (solution) (1) (pale) blue precipitate /solid /crystals (insoluble in excess) (1)</p> <p>OR</p> <p>Add zinc / Zn / magnesium / Mg (1) Brown solid /crystals / precipitate (1)</p> <p>IGNORE</p> <p>Identity of cation at this point</p> <p>No TE on incorrect cations</p> <p>Reagent / flame test mark standalone</p>	<p>Pale green</p> <p>Green ppt</p>	2

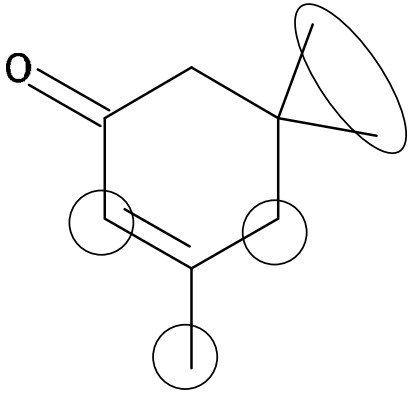
Question Number	Acceptable Answer	Reject	Mark
1 (g)	(Add dilute nitric acid to a solution of A then) add (aqueous) silver nitrate / $\text{AgNO}_3(\text{aq})$ (1) White precipitate (soluble in dilute aqueous ammonia) (1) OR Add concentrated / conc sulfuric acid / H_2SO_4 (1) Steamy / misty / white fumes (1) IGNORE Identity of anion at this point No TE on incorrect anions	Sulfuric acid Additional reagents e.g. NaOH (loses MP1 only) smoke Just 'fumes'	2

Question Number	Acceptable Answer	Reject	Mark
1 (h)	(Yellow colour due to) $[\text{CuCl}_4]^{2-}$ (1) (Green colour due to) $[\text{CuCl}_3]^-$ ALLOW $\text{CuCl}_2 / [\text{CuCl}]^+$ OR A mixture of $[\text{Cu}(\text{H}_2\text{O})_6]^{2+} / \text{Cu}^{2+}(\text{aq})$ and $[\text{CuCl}_4]^{2-}$ (1) IGNORE water ligands on chloro copper ions and CuCl_2 Omission of square brackets		2

(Total for Question 1 = 13 marks)

Question Number	Acceptable Answer				Reject	Mark
2 (a)	Functional group	Test	Result			4
	Alkene	Bromine (water / solution)	(Brown /orange /yellow to) colourless	(2)		
		OR Acidified potassium manganate(VII)	(Purple to) colourless			
Ketone ALLOW carbonyl	2,4-dinitro phenylhydrazine OR Brady's reagent ALLOW (2,4-)DNP(H)	Orange / yellow / red and precipitate	(2)			
<p>For each functional group: all three points scores 2; functional group and test reagent alone scores 1; test and result alone scores 1</p> <p>Use of just C=C for alkene and / or just C=O for ketone max 3</p> <p>IGNORE Test for aldehyde group with negative result</p> <p>No TE on incorrect test</p> <p>If no other marks scored then identifying both functional groups scores 1</p>						

Question Number	Acceptable Answer	Reject	Mark
2(b)(i)	<p>Singlet because neither of the adjacent /neighbouring carbon atoms has a hydrogen / proton attached</p> <p>ALLOW Singlet because no adjacent /neighbouring / nearby hydrogen(s) / proton(s)</p> <p>'No splitting' / one peak for 'singlet'</p>	Just 'singlet'	1

Question Number	Acceptable Answer	Reject	Mark
2(b)(ii)	<div style="text-align: center;">  </div> <p>MP1 (standalone mark) The top methyl group proton environments fully identified and linked in some way (1)</p> <p>MP2 The other three proton environments (1)</p> <p>MP2 may only be awarded if there are no errors on the rest of the molecule apart from the top methyl groups</p> <p>Likely errors: omission of a proton environment / incorrectly linked proton environments / additional protons</p> <p>ALLOW</p> <p>Any other labels of the proton environments</p>		2

(Total for Question 2 = 7 marks)

Question Number	Acceptable Answer	Reject	Mark
3(a)(i)	<p>Amount of iron = $5.00/55.8$ (mol) (1) = amount H_2SO_4 (= $0.089606 / 8.9606 \times 10^{-2}$ (mol))</p> <p>Volume of $2.00 \text{ mol dm}^{-3} H_2SO_4$ required = $5.00/55.8 \div 2$ = $0.044803 / 4.4803 \times 10^{-2} \text{ dm}^3$</p> <p>OR = 44.803 cm^3 (1)</p> <p>If $A_r(\text{Fe}) = 56$, volume = 0.044643 dm^3 (= 44.643 cm^3)</p> <p>TE on incorrect mol</p> <p>IGNORE all SF and rounding errors except 1 SF on final answer, and rounding errors affecting final answer</p>	Units incorrect or omitted	2

Question Number	Acceptable Answer	Reject	Mark
3(a)(ii)	<p>To remove solid impurities</p> <p>ALLOW Undissolved solids OR Insoluble impurities</p>	To remove unreacted iron	1

Question Number	Acceptable Answer	Reject	Mark
3(a)(iii)	<p>Evaporate the solution to crystallization point OR until crystals /solids begin to form</p> <p>ALLOW Concentrate the solution by evaporation OR Reduce the volume by 25 – 75 % (1)</p> <p>(Cover solution and) allow to stand / cool and dry crystals between filter papers</p> <p>ALLOW Dry in a warm oven / desiccator (1)</p> <p>IGNORE Filtering Points relating just to recrystallization</p>	<p>Just 'evaporate the solution' OR Evaporate all water OR Distillation</p> <p>Dry the solution</p> <p>$T > 80^\circ\text{C}$ Hot oven</p>	2

Question Number	Acceptable Answer	Reject	Mark
3 (a) (iv)	<p>Mr (FeSO₄.7H₂O) = 277.9 ALLOW</p> <p style="text-align: right;">= 278 (1)</p> <p>Maximum yield = 277.9 x 5.00 ÷ 55.8 (1) = 277.9 x 0.08961 (= 24.901 g)</p> <p>89.5% yield = 0.895 x 277.9 x 5.00/55.8 = 22.287 (g)</p> <p>OR</p> <p>If A_r(Fe) = 56 and A_r(S) = 32 89.5% yield = 22.215 (g) (1)</p> <p>TE at each stage</p> <p>IGNORE SF except 1 SF</p> <p>Correct answer with no working scores 3</p> <p>Additional Comment The 89.5% yield can be applied to the mass of iron, the mass of FeSO₄.7H₂O or the moles of FeSO₄.7H₂O to gain MP3</p>		3

Question Number	Acceptable Answer	Reject	Mark
3(b)(i)	<p>These marks are standalone</p> <p>Transfer solution to a volumetric / graduated / standard flask (1)</p> <p>add washings (1)</p> <p>Make up to mark / line / 250 cm³ (with distilled water / dilute sulfuric acid) and then mix (1)</p> <p>ALLOW Different indication of mixing (e.g. swirl / invert / stir). Mixing must follow making up to mark</p> <p>IGNORE reference to weighing bottle and mixing when dissolving solid and washings from the weighing</p>		3

Question Number	Acceptable Answer	Reject	Mark
3(b)(ii)	<p>(Pale green solution turns) yellow /orange / brown</p> <p>OR</p> <p>(Pale green solution forms) yellow /orange / brown (solution / cloudy solution / precipitate (1)</p> <p>Because (some of) the iron(II) / Fe²⁺ ions are oxidized (to iron(III) / Fe³⁺)</p> <p>OR</p> <p>iron(III) / Fe³⁺ ions are formed (from iron(II) / Fe²⁺ ions)</p> <p>ALLOW</p> <p>Fe(OH)₃ formed (1)</p>	<p>red</p> <p>red</p> <p>Just 'oxidation'</p>	2

Question Number	Acceptable Answer	Reject	Mark
3(b)(iii)	(colourless /pale yellow to first permanent pale) pink	(colourless /pale yellow to purple / mauve purple to pink pink / purple to colourless	1

Question Number	Acceptable Answer	Reject	Mark
3(b)(iv)	<p>Amount of $\text{MnO}_4^- = 25.35 \times 0.0195/1000$ $= 4.94325 \times 10^{-4} \text{ (mol) (ans*)}$ (1)</p> <p>Amount of Fe^{2+} in 250 cm^3 $= 5 \times 10 \times \text{ans* (ans**)}$ (1) $= 0.024716 \text{ (mol)}$</p> <p>Mass of 1 mol of $\text{FeSO}_4 \cdot x\text{H}_2\text{O}$ $= 6.75 \div \text{ans**}$ $= 273.10 \text{ (g) (ans***)}$ (1)</p> <p>IGNORE SF except 1 SF up to this point</p> <p>Correct molar mass with no working scores first 3 marks</p> <p>Moles of water of crystallization $= (\text{ans***} - 151.9)/18 = 6.7333 = 6.7=7$ (1)</p> <p>If $A_r(\text{Fe}) = 56$, $x = 6.7278$</p> <p>TE at each stage</p> <p>Final answer = 7 with no working scores 0</p>		4

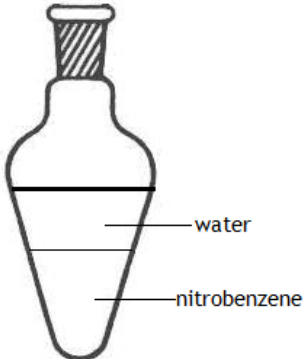
Question Number	Acceptable Answer	Reject	Mark
3 (c) (i)	<p>$M_r(\text{FeSO}_4 \cdot 7\text{H}_2\text{O}) = 277.9$ uncertainty = $277.9 \times 0.9/100 = (\pm)2.501$</p> <p>ALLOW</p> <p>$M_r(\text{FeSO}_4 \cdot 7\text{H}_2\text{O}) = 273$ (from 3b(iv) is used (uncertainty = $(\pm)2.458$)</p> <p>OR</p> <p>$M_r(\text{FeSO}_4 \cdot 7.1\text{H}_2\text{O}) = 279.7$ is used (uncertainty = $(\pm)2.517$) (1)</p> <p>(∴ answers = 277.9 ± 2.5 are within experimental uncertainty)</p> <p>Using $x = 7.1$ gives $M_r(\text{FeSO}_4 \cdot 7\text{H}_2\text{O}) = 279.7$ and this is within the uncertainty range (1)</p> <p>If neither mark is scored</p> <p>ALLOW Answer must be an integer so only needs to be in the range 6.6 to 7.4 for 1 mark</p> <p>IGNORE Calculations based on the percentage difference between 7.1 and 7</p>		2

Question Number	Acceptable Answer	Reject	Mark
3 (c) (ii)	<p>The crystals were not dry OR Some of the iron(II) had been oxidized (to iron(III)) OR iron(II) / Fe^{2+} ions converted into iron(III) / Fe^{3+} ions</p> <p>IGNORE impurities / transfer errors / titration errors</p>	Titration value too large	1

(Total for Question 3 = 21 marks)

Question Number	Acceptable Answer	Reject	Mark
4 (a) (i)	(boiling) water / H ₂ O OR water /H ₂ O to produce steam OR Distilled / deionised water	Just 'steam'	1

Question Number	Acceptable Answer	Reject	Mark
4 (a) (ii)	Prevents pressure building up (by allowing gases / vapours to escape). ALLOW To prevent explosion 'air' for gases / vapours IGNORE To allow gases / vapours to escape		1

Question Number	Acceptable Answer	Reject	Mark
4 (a) (iii)	 <p>Two layers labelled water /H₂O & nitrobenzene / C₆H₅NO₂ (1) Water on top OR nitrobenzene on bottom (1)</p>	Just 'Oily /organic layer' (for nitrobenzene)	2

Question Number	Acceptable Answer	Reject	Mark
4 (b)	Use a separating funnel to remove the nitrobenzene ALLOW Dropping funnel / teat pipette (1) Dry the nitrobenzene (1) Using (anhydrous) calcium chloride / CaCl ₂ OR magnesium sulfate / MgSO ₄ OR sodium sulfate / Na ₂ SO ₄ OR calcium sulfate / CaSO ₄ (1) IGNORE decanting / distillation	dehydrate copper(II) sulfate cobalt(II) chloride silica gel	3

Question Number	Acceptable Answer	Reject	Mark
4c(i)	Toxic and flammable ALLOW Poisonous / poison for toxic and inflammable for flammable	Corrosive Hazardous	1

Question Number	Acceptable Answer	Reject	Mark
4c(ii)	Vent B into a fume cupboard / to the outside / through an (open) window / down the drain IGNORE Vent into another container ALLOW Put the apparatus in fume cupboard / carry out in fume cupboard Fume hood / chamber IGNORE water bath / electrical heater / anti bumping granules / gloves		1

(Total for Question 4 = 9 marks)

TOTAL FOR PAPER = 50 Marks