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Mark Scheme (Results)

January 2016

Pearson Edexcel International Advanced Level in Chemistry (WCH03) Paper 01 – Chemistry Laboratory Skills I

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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 Answers	Reject	Mark
1(a)	**A** Nichrome / Nickel-Chromium /Platinum / Pt (wire) **(1)** **B** (Concentrated) HCl(aq)/ (Concentrated) hydrochloric acid **(1)** ALLOW Just 'HCl' Dilute HCl/Dilute hydrochloric acid	Just" Nickel" Just "Chromium" HCl **(g)** Hydrogen chloride Any other named acids	**2**

Question Number	Acceptable Answers	Reject	Mark
1(b)	(Group 1 cation) Lithium/Li^+ ALLOW Rubidium/Rb^+ **(1)** (Group 2 cation) Magnesium/Mg^{2+} **(1)** If the name and formula are given then both must be correct If two ions are given for one cation both must be correct Penalise omission of / incorrect charges on symbols once only Standalone marks	Li Rb Mg	**2**

Question Number	Acceptable Answers	Reject	Mark
1(c)(i)	Effervescence/Fizzing/Bubbles IGNORE Gas / carbon dioxide / CO_2 given off	Reference to any colour Fumes	1

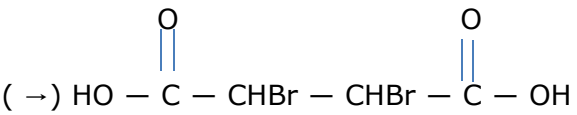
Question Number	Acceptable Answers	Reject	Mark
1(c)(ii)	Hydrogencarbonate/HCO_3^- **(1)** If the name and formula are given then both must be correct ALLOW Sulfite/sulfate(IV)/SO_3^{2-}/ Thiosulfate/$S_2O_3^{2-}$/ Sulfide/S^{2-}	 Sulfate / Sulfate(VI)/ SO_4^{2-}	1

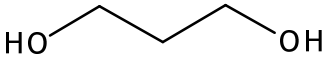
Question Number	Acceptable Answers	Reject	Mark
1(c)(iii)	$MgSO_4$ ALLOW any Group 2 sulfate **(1)** Li_2SO_4 /Rb_2SO_4 ALLOW any Group 1 sulfate **(1)** Salts can be in either order IGNORE Names Sulfites/ SO_3^{2-} /Sulfate/SO_4^{2-} with incorrect cations or formulae scores (1)		2

(TOTAL FOR QUESTION 1 = 8 MARKS)

Question Number	Acceptable Answers	Reject	Mark
2(a)(i)	Rate of reaction between **solids** is slow OR Difficult for two **solids** to react easily ALLOW Both (acid(s) and reagent) are **solid** IGNORE reference to any need for heating	"Dissolves" for "reacts"	1

Question Number	Acceptable Answers	Reject	Mark
2(a)(ii)	**Marking point 1** Sodium/potassium carbonate **and** solution/aqueous/water OR Sodium/potassium hydrogencarbonate **and** solution/aqueous/water **(1)** **Marking point 2** Effervescence/Fizzing/Bubbles **(1)** **MP2** conditional on **MP1** ALLOW **MP2** for effervescence etc. for any carbonate/hydrogencarbonate given as reagent OR **Marking point 1** Named alcohol + named strong acid **(1)** **Marking point 2** Fruity smell **(1)** **MP2** conditional on **MP1**	Sodium/Na Indicators	2

Question Number	Acceptable Answers	Reject	Mark
2(b)	 (→) HO — C — CHBr — CHBr — C — OH OR Displayed formula IGNORE Position of the bond to the hydrogen of the OH group	Additional products	1

Question Number	Acceptable Answers	Reject	Mark
2(c)(i)	 Ignore bond lengths, bond angles, and bond between O and H	Bond clearly to the hydrogen of the OH group e.g. –HO	1

Question Number	Acceptable Answers	Reject	Mark
2(c)(ii)	Peak/Absorption/Absorbance/Trough for C=O (only) present in propanedioic acid infrared spectrum ALLOW Peak/Absorption/Absorbance/Trough for C=O absent from propane-1,3-diol infrared spectrum OR O-H peak/absorption/trough for carboxylic acid has a different wavenumber to that for the alcohol OR Different fingerprint region	Line	1

(TOTAL FOR QUESTION 2 = 6 MARKS)

Question Number	Acceptable Answers	Reject	Mark
3(a)	To avoid (loss of solid due to) 'spitting' ALLOW To prevent loss of solid/reactant IGNORE reference to water vapour	Spillage Removal of impurities	1

Question Number	Acceptable Answers	Reject	Mark
3(b)	Heat to constant mass/weight IGNORE Keep heating until .... no more steam/misty fumes are given off OR there is no further reaction OR the crystals turn to powder		1

Question Number	Acceptable Answers	Reject	Mark
3(c)	Anhydrous (sodium carbonate)	Dry/Dehydrated	1

Question Number	Acceptable Answers	Reject	Mark
3(d)(i)	**Additional Comments** **Throughout 3d,** **correct answers score full marks** **and** **ignore SF (including 1SF)** **and** **penalise incorrect units once only** (M_r Na_2CO_3=) 2x23 + 12 + 3x16 / 106 (g mol^{-1}) **(1)** (1.06 ÷ 106 =) 0.01/ 1.0 x 10^{-2} (mol) **(1)** TE for incorrect M_r		2

Question Number	Acceptable Answers	Reject	Mark
3(d)(ii)	(m= 2.50 – 1.06 = 1.44(g) n = 1.44 ÷18=) 0.08 (mol)		1

Question Number	Acceptable Answers	Reject	Mark
3(d)(iii)	(0.08 ÷ 0.01 =) 8 TE from (d)(i) and (d)(ii)		1

Question Number	Acceptable Answers	Reject	Mark
3(e)	Washings/Rinsing (from the beaker) should have been transferred to the volumetric flask		1

Question Number	Acceptable Answers	Reject	Mark
3(f)	Titration 1 is not concordant/a range finder/ an overshot/ an outlier/a trial /only a 'rough'/ more than 0.2 cm^3 from the other 2 titres IGNORE Inaccurate OR (Titrations 2 and 3) are within 0.1/0.2 cm^3/concordant IGNORE More accurate		1

Question Number	Acceptable Answers	Reject	Mark
3(g)(i)	**Throughout 3g ignore SF except 1SF** (Mean titre = 16.5 cm^3/ 0.0165 dm^3) n=(0.10 x 0.0165=) 1.65 x 10^{-3}/0.00165 (mol) Correct answer with no working scores (1) No TE on incorrect mean		1

Question Number	Acceptable Answers	Reject	Mark
3(g)(ii)	n=(1.65 x 10^{-3} ÷ 2=) 8.25 x 10^{-4}/0.000825 (mol) TE Ans to (g) ÷ 2		1

Question Number	Acceptable Answers	Reject	Mark
3(g)(iii)	n(8.25 x 10^{-4} x 10=) 8.25 x 10^{-3}/0.00825 (mol) TE Ans to (g)(ii) x 10		1

Question Number	Acceptable Answers	Reject	Mark
3(g)(iv)	M_r=(2.50 ÷ 8.25 x 10^{-3} =) 303.03 **(1)** (303.03 -106 = 197.03 then 197.03 ÷ 18=) (x =) 10.946/10.95/10.9/11 **(1)** Alternative Methods M_r = 106 + 18x Mass = (8.25 x 10^{-3}) x M_r = 0.8745 + 0.1485x **(1)** 2.50 = 0.8745 + 0.1485x X=(2.50-0.8745) ÷ 0.1485 = 10.946 **(1)** OR Mass Na_2CO_3 = 8.25x10^{-3} x106 = 0.8745(g) Mass H_2O = 2.5 – 0.8745 = 1.6255 **(1)** Mol H_2O = 1,6255÷18 = 0.0903 X = 0.0903÷ 8.25x10^{-3} = 10.946 **(1)** TE from previous answers Correct final answer with/without working scores (2)		2

Question Number	Acceptable Answers	Reject	Mark
3(h)	**Marking point 1** The number of moles of sodium carbonate would be too large **OR** the molar mass of hydrated salt would be too small **(1)** **Marking point 2** Hence the value of x would be too small/low **(1)** MP2 is **not** standalone and may be awarded only if one or other of the statements for the first mark is given No TE on incorrect MP1		2

(TOTAL FOR QUESTION 3 = 16 MARKS)

Question Number	Acceptable Answers	Reject	Mark
4(a)(i)	**Additional Comment** **For parts (i), (ii),** **correct answers score full marks** **and** **ignore SF (except 1SF)** **and** **penalise incorrect units once only** **and** **penalise incorrect rounding once only** (energy = 50.0 x 4.18 x 4.7 =) 982.3 (J) /982 ALLOW 0.9823 **kJ** IGNORE any sign		1

Question Number	Acceptable Answers	Reject	Mark
4(a)(ii)	(n = 2.54 ÷ 123.5 =) 0.0206/0.0205668 (mol)		1

Question Number	Acceptable Answers	Reject	Mark
4(a)(iii)	ΔH = (0.9823 ÷ 0.0205668 =) 47.76144 (kJ mol^{-1}) **(1)** −47.8 (kJ mol^{-1}) **(1)** Sign and 3 SF required for second mark TE on ans (a)(i) ÷ ans (a)(ii)		2

Question Number	Acceptable Answers	Reject	Mark
4(a)(iv)	To ensure that enthalpy change is per mol of copper(II) carbonate OR So that the limiting factor is the mass of copper(II) carbonate ALLOW To ensure all copper(II) carbonate reacts IGNORE To ensure the reaction goes to completion OR So sulfuric acid is not a limiting factor		1

Question Number	Acceptable Answers	Reject	Mark
4(a)(v)	Heat loss OR Heat capacity of apparatus is not negligible ALLOW Copper(II) carbonate contains copper(II) hydroxide OR Specific heat capacity of solution is not 4.18 IGNORE Non-standard conditions/ Just impurities	Incomplete reaction By-products Side reactions	1

Question Number	Acceptable Answers	Reject	Mark
4(b)	$\Delta H_3 = \Delta H_4 - \Delta H_5$ **(1)** $\Delta H_3 = -47.8 - -56.1 = +8.3$ (kJ mol^{-1}) OR $\Delta H_3 = -47.7 - -56.1 = +8.4$ (kJ mol^{-1}) **(1)** Answer alone scores (2) IGNORE SF TE on 4(a)(iii) No TE on incorrect Hess' Law		2

Question Number	Acceptable Answers	Reject	Mark
4(c)	Difficult to measure heat absorbed when heating any substance OR Difficult to measure the temperature (change) of a solid OR Difficult to measure the temperature change when heating	Just 'it's endothermic'	1

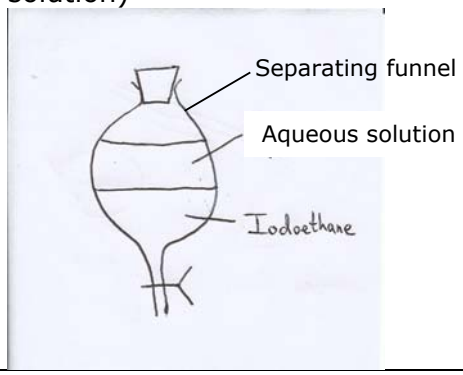
(TOTAL FOR QUESTION 4 = 9 MARKS)

Question Number	Acceptable Answers	Reject	Mark
5(a)	Reaction is (extremely) exothermic IGNORE Vigorous Violent Reactive Dangerous Explosive		1

Question Number	Acceptable Answers	Reject	Mark
5(b)(i)	Condenser doesn't fill properly/airlock forms ALLOW inefficient condensation/inefficient cooling/air bubbles form IGNORE Reference to the time taken for condensation	No condensation	1

Question Number	Acceptable Answers	Reject	Mark
5(b)(ii)	(Error) (left hand side of apparatus) open at the top / no stopper at the top **and** (Effect) (vapours of) iodoethane / product / reaction mixture will escape ALLOW "evaporate" for "escape" IGNORE Gas(es) / fumes will escape Reactants /ethanol escaping References to missing thermometer		1

Question Number	Acceptable Answers	Reject	Mark
5(c)	Remove/Neutralize/React with phosphoric acid/ H_3PO_3 ALLOW Remove/Neutralize/React with HI/acid IGNORE References to "excess" (acid)	Any other specific acid	1

Question Number	Acceptable Answers	Reject	Mark
5(d)	**All marks standalone** **Marking point 1** Separating funnel/ tap funnel/ dropping funnel **(1)** **Marking point 2** Diagram of a funnel with tap **and** stopper OR Diagram of a funnel with tap **and** a definite neck capable of taking a stopper **(1)** **Marking point 3** Two layers with lower layer labelled as iodoethane **and** top layer as aqueous solution) **(1)**  	Filter funnel with or without stopper	3

Question Number	Acceptable Answers	Reject	Mark
5(e)	Go clear/cloudiness will disappear ALLOW Less cloudy IGNORE colourless	Any specified colour	1

Question Number	Acceptable Answers	Reject	Mark
5(f)	Decanted/poured off/(teat) pipette/ filtered through glass wool IGNORE Just "filtered"		1

Question Number	Acceptable Answers	Reject	Mark
5(g)	(re)distillation ALLOW Fractional distillation IGNORE references to a specified temperature range		1

Question Number	Acceptable Answers	Reject	Mark
5(h)	(Iodide ions) are oxidized and (form iodine) ALLOW (Iodide ions) turn into iodine IGNORE references to the colour or state of the iodine product		1

(TOTAL FOR QUESTION 5 = 11 MARKS)

(TOTAL FOR PAPER = 50 MARKS)