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Mark Scheme (Results)

January 2014

IAL Chemistry (WCH06/01)
Unit 6: 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.
- 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	Correct Answer	Reject	Mark
1(a)	Any **two** from: Fe^{2+} / $Fe(H_2O)_6^{2+}$ Ni^{2+} / $Ni(H_2O)_6^{2+}$ Cr^{3+} / $Cr(H_2O)_6^{3+}$ Allow Cu^{2+} Ignore names As usual: 1 correct and 1 incorrect scores 1 2 correct and 1 incorrect scores 1 3 correct and 1 incorrect scores 2	Cr^{2+} $Cu(H_2O)_6^{2+}$ $Cu(H_2O)_4^{2+}$	**2**

Question Number	Correct Answer	Reject	Mark
1(b)(i)	Fe^{2+} / $Fe(H_2O)_6^{2+}$ Ignore names		**1**

Question Number	Acceptable Answers	Reject	Mark
1(b)(ii)	$Fe(OH)_2$/ $Fe(H_2O)_4(OH)_2$ / $Fe(OH)_2(H_2O)_4$ Ignore names TE if Ni^{2+} in (b)(i) then $Ni(OH)_2$/ $Ni(H_2O)_4(OH)_2$ / $Ni(OH)_2(H_2O)_4$ score 1. No TE for Cr^{3+}		**1**

Question Number	Acceptable Answers	Reject	Mark
1(b)(iii)	$Fe(OH)_3$/ $Fe(H_2O)_3(OH)_3$ / $Fe(OH)_3(H_2O)_3$ Ignore names No TE from (b)(i) ALLOW: Fe_2O_3 with or without water		**1**

Question Number	Acceptable Answers	Reject	Mark
1(b)(iv)	Oxidation / redox (reaction) Additional information may be given and can be ignored, e.g. 'green precipitate undergoes oxidation'. ALLOW: Oxidation and reduction	Just 'reduction'	**1**

Question Number	Acceptable Answers	Reject	Mark
1(c)	Purple to colourless/pale yellow/brown Both required OR Purple (solution) decolourised Allow Pink for purple OR Green to yellow/brown	Colourless to purple Green to purple	**1**

Question Number	Acceptable Answers	Reject	Mark
1(d)(i)	Cl^-(ion) Ignore names: e.g. Chlor**ide** (ion) Iron(II) chloride	Cl $FeCl_2$ Chlor**ine** ion	**1**

Question Number	Acceptable Answers	Reject	Mark
1(d)(ii)	Ammonia reacts with the iron ions to form a precipitate OR A precipitate forms **(1)** **Second mark** (A precipitate of) Iron(II) hydroxide/ Iron(III) hydroxide/ $Fe(OH)_2$/ $Fe(H_2O)_4(OH)_2$/ $Fe(OH)_3$/ $Fe(H_2O)_3(OH)_3$ (forms) OR Obscures the dissolving of the white precipitate (OWTTE e.g. masks precipitate) **(1)** **ALLOW** Precipitate should dissolve but here ammonia is neutralised by nitric acid **(1 max)**		**2**

(Total for Question 1 = 10 marks)

Question Number	Acceptable Answers	Reject	Mark
2(a)	$CuCl_4^{2-}$/$[CuCl_4]^{2-}$ /$(CuCl_4)^{2-}$/$[Cu(Cl)_4]^{2-}$	$CuCl_4$ Correct formula with added H_20	**1**

Question Number	Acceptable Answers	Reject	Mark
2(b)	(pale) blue **precipitate** **(1)** Ignore gelatinous in front of precipitate but not in front of solution in next part. precipitate dissolves (in excess ammonia)/ precipitate disappears/soluble/solution forms **(1)** deep/dark(er)/royal blue(solution) **(1)** deep blue solution forms scores 2nd and 3rd marks Marks stand alone Ignore formulae even if incorrect	Just "blue"	**3**

Question Number	Acceptable Answers	Reject	Mark
2(c)(i)	($2S_2O_3^{2-}$ + $I_2 \rightarrow$) $S_4O_6^{2-}$ + $2I^-$ Ignore state symbols even if incorrect		**1**

Question Number	Acceptable Answers	Reject	Mark
2(c)(ii)	mol $S_2O_3^{2-}$ = 17.85 x 0.120/1000 **(1)** = 2.142 x 10^{-3}/0.002142 mol Cu^{2+} = 2.142 x 10^{-3} in 25 cm^3 total mol Cu^{2+} = 2.142 x 10^{-3} x 250/25 **(1)** **=** 2.142 x 10^{-2}/0.02142 [$CuSO_4$] = 2.142 x 10^{-2} x 1000/20.0 = 1.07(1) (mol dm^{-3}) **(1)** Ignore sf except 1 sf Correct answer with no working **(3)** 0.107 (mol dm^{-3}) **2 max** Check unfinished calculation not finished on next page 2nd and 3rd marks can be transferred errors	1 sf 1.0/1	**3**

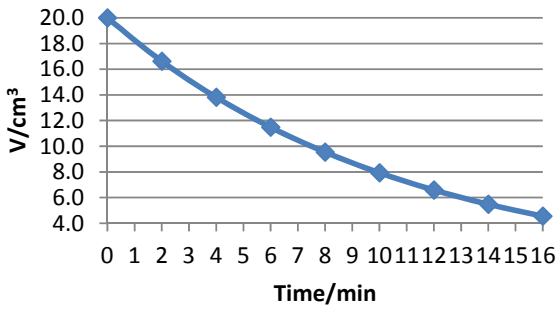
(Total for Question 2 = 8 marks)

Question Number	Acceptable Answers	Reject	Mark
3(a)	To quench/stop/slow the reaction ALLOW freeze IGNORE: to reduce reactivity exothermic reaction/reaction gives our heat		**1**

Question Number	Acceptable Answers	Reject	Mark
3(b)	Phenolphthalein **and** one of the following: (Indicator) range /colour change corresponds to steep change in pH. OR (Indicator) range /colour change corresponds to vertical/steep region of pH titration curve OR (change in) pH range 7.1 - 12/ above 7 OR (change in) pH range of methyl orange is below 7/ range 6.9 - 3 OR pK_{in} is greater than 7, or any number greater than 7 and less than 14. (correct value is 9.3) OR changes colour at/near equivalence point OR carboxylic acid is a weak acid OR weak acid – strong base titration	strong acid – strong base titration	**1**

Question Number	Acceptable Answers	Reject	Mark
3(c)(i)	Catalyst/hydrochloric acid/HCl reacts with the sodium hydroxide ALLOW Acid in (initial) solution		1

Question Number	Acceptable Answers	Reject	Mark
3(c)(ii)	(More) (carboxylic) acid is formed	More product is formed	1

Question Number	Acceptable Answers	Reject	Mark
3(d)	 Axes labelled with quantity and **units** Note unit for time must be min not s **(1)** Points correctly plotted using at least half the graph paper in both dimensions Smooth curve through points **(1)** Allow one mis-plot provided curve is smooth Two half lives found in range 7.2 - 7.8 (mins) Ignore seconds for units (half lives need not be successive) **(1)** First order (this mark depends on two close values in third mark) **(1)** Note: If second half life is 15.2 etc. , then 3rd and 4th marks lost		4

Question Number	Acceptable Answers	Reject	Mark
3(e)	Orange to green/blue/brown Both colours required IGNORE: Qualifications of colour, e.g. dark green	Combinations of blue and green	1

Question Number	Acceptable Answers	Reject	Mark
3(f)(i)	**Correct** names or formulae are acceptable, e.g. sodium hydrogencarbonate (allow sodium bicarbonate)	Indicators sodium hydroxide	2

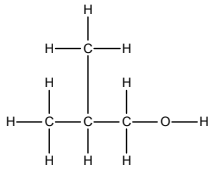
Reagent **(1)**	Observation **(1)**	
Na_2CO_3(aq)/$NaHCO_3$ (aq)/$CaCO_3$((s))	Effervescence/ fizzing	$NaCO_3$ Loses reagent mark
Allow solid Na_2CO_3/$NaHCO_3$	Allow: Testing gas with limewater which turns cloudy; Neutralises large volume	$LiALH_4$
PCl_5	Misty/steamy/white fumes	White smoke
Alcohol (+ mineral acid)	Fruity smell	Just ester formed
Na / Mg	Effervescence/ fizzing	

Question Number	Acceptable Answers	Reject	Mark
3(f)(ii)	2,4-dinitrophenylhydrazine/2,4-DNP(H) /DNP(H)/Brady's reagent **(1)** red/orange/yellow **precipitate** **(1)** Or Iodine and sodium hydroxide **(1)** Yellow precipitate **(1)** Ignore references to antiseptic smell	Colour only Colour only	2

	Ignore references to Tollens, Bendict's, Fehling's and result (ie no TE)		

Question Number	Acceptable Answers	Reject	Mark
3(g)	Primary ALLOW: 1° OR $-CH_2OH$ IGNORE: Names		1

Question Number	Acceptable Answers	Reject	Mark
3(h)(i)	**4 different H / hydrogen / proton environments**	4 different kinds of H 4 different environments	1

Question Number	Acceptable Answers	Reject	Mark
3(h)(ii)	 accept $-OH/CH_3$ ALLOW correct skeletal formula correct structural formula e.g. $CH_3CH(CH_3)CH_2OH$ OR Part structural, part displayed formula OR	Molecular formula OHC/O-H-C where there are clearly two bonds to hydrogen	1

	Vertical bond to OH wherever it finishes		

Question Number	Acceptable Answers	Reject	Mark
3(h)(iii)	H on the OH group OR OH group ALLOW TE for OH/H on wrong isomer	O alone COH	1

(Total for Question 3 = 17 marks)

Question Number	Acceptable Answers	Reject	Mark
4(a)	Hazard: flammable Precaution: keep away from naked flames/ use electrical heating/mantle or use water bath **(1)** Hazard: corrosive Precaution: wear gloves **(1)** Precaution must relate to appropriate hazard 2 correct hazards with no precautions **(0)** IGNORE Use of fume cupboard	Keep away from sources of heat Avoid direct heat	2

Question Number	Acceptable Answers	Reject	Mark
4(b)	Round-bottom/pear shape flask with vertical reflux condenser , drawn or labelled **(1)** Condenser jacket drawn at with water in at bottom, out at top **(1)** Heating source e.g. heating mantle/electric heater/water bath/ oil bath **(1)** ALLOW Water/oil bath heated by Bunsen burner Fully correct distillation apparatus **(1 max)** If both reflux and distillation diagrams drawn, then 2 marks max	Conical flask Bunsen burner Arrow (labelled or unlabelled) Closed apparatus/ large air gaps in wrong places loses an additional mark	3

Question Number	Acceptable Answers	Reject	Mark
4(c)	Prevents superheating/ localised heating ALLOW: Violent boiling OR Promotes smooth/even/uniform boiling OR Promotes smooth/even/uniform heating IGNORE prevents vigorous reactions/(large)bubbles/splashing	Just "stops bumping" Just: Violent reaction Just: Prevent explosion Just: Prevent mixture rising up condenser	1

Question Number	Acceptable Answers	Reject	Mark
4(d)	To remove/react with/neutralize the (unreacted)(ethanoic) **acid**		1

Question Number	Acceptable Answers	Reject	Mark
4(e)	Anhydrous sodium sulfate **(1)** Others would react with/decompose product/ester Sodium sulfate does not react with/ decompose product/ester **(1)** **Second mark depends on first**	Others "too strong" Easiest to separate The only neutral one	2

Question Number	Acceptable Answers	Reject	Mark
4(f)	Start 139-141^{o}C End 143-145^{o}C Both required for the mark	Single temperature	1

Question Number	Acceptable Answers	Reject	Mark
4(g)(i)	Mass 3-methylbutan-1-ol = 0.81 x 10.0 **(1)** = 8.10(g) Mol 3-methylbutan-1-ol = 8.10/88.0 = 0.09204545 Mol product = 0.09205 (0.0920 and 0.092 are both allowed for this step) **(1)** Mass of product = 0.09205 x 130.0 = 12.0 (g) to 3 sf **(1)** Correct answer with no working 3 marks **(3)** With consequential marks, the last mark is lost if the candidate's data is not rounded correctly to 3 sf. 0.09 gives 11.7 **(2 max)** 0.092 gives 12.0 **(3)**	0.09/0.0921	3

Question Number	Acceptable Answers	Reject	Mark
4(g)(ii)	**EITHER** % yield = 9.45/(ans to 4(g)(i)) x 100 **(1)** = correct value **(1)** N.B. correct value: % yield = 9.45/12.0 x 100 = 78.75% = 79% **OR** $\frac{9.45}{130}$ = 0.07269 (mol) **(1)** $\frac{0.07269}{0.09205} \times 100$ = 78.9680% = 79% **(1)** Accept any answer that rounds to 79 to two sf Allow TE from (i) for full credit unless greater than 100% in which case (**1max**)		2

(Total for Question 4 = 15 marks)

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