Mark Scheme (Results)

January 2018

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 respons

Question Number	Correct Answer	Reject	Mark
1(a)	Ignore any mention of preheating sample **MP1** (Dip clean) nichrome / platinum wire ALLOW NiCr for nichrome loop / rod for wire OR Silica rod (1) IGNORE inoculating / flame-test (wire) **MP2 (Mark independent of MP1)** in (concentrated) hydrochloric acid / HCl(aq) ALLOW any mention of HCl(aq) e.g. cleaning or mixing solid and acid or making a paste/solution HCl for HCl(aq) (1) IGNORE Dilute ALLOW (for MP1 and MP2) (Wooden) splint (in place of a wire) (1) Soaked in distilled / deionised water (1) **MP3** then dipped in solid **and** placed in (hot / roaring /colourless/ blue-cone) (Bunsen) **flame** ALLOW salt / compound / substance / paste /sample/ solution for 'solid' On / over / under / near / show / above for 'in' (1) **MP4:** Result: yellow-red/ red/brick-red/ orange –red (1)	Nickel / chrome / chromium Spatula Test tube Other acids Just 'water' Just 'Bunsen' In yellow flame Orange Crimson-red	**(4)**

Question Number	Correct Answer	Reject	Mark
1(b)	**EITHER** Substance: (anhydrous) cobalt(II) chloride (paper) ALLOW Cobalt chloride/CoCl$_2$ (1) Colour change: turns from blue to pink (1) **OR** Substance: (anhydrous) copper(II) sulfate ALLOW copper sulfate/CuSO$_4$ (1) Colour change: turns from white to blue (1) If name **and** formula of reagents are given, both must be correct Ignore formula of product Colour change mark dependent on test reagent being correct (or a near miss e.g. cobalt paper or CoCl)	Boiling temperature is 100°C Test with litmus Test with universal indicator	(2)

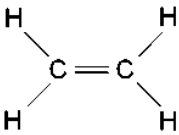| Question Number	Acceptable Answers	Reject	Mark
1c(i)	Nitrogen dioxide/nitrogen(IV) oxide/NO$_2$ **and** is brown/red-brown/reddish-brown ALLOW dinitrogen tetroxide/N$_2$O$_4$ **and** brown/ red-brown	nitrite ion red other colours	(1)

Question Number	Acceptable Answers	Reject	Mark
1c(ii)	Oxygen/ O_2 **and** relights a glowing splint ALLOW Makes a lighted splint burn more brightly If the gases in (i) and (ii) are both identified correctly but either NO_2 colour or O_2 test is wrong, give 1 mark in c(ii).	Growing / sparkling splint	(1)

Question Number	Acceptable Answers	Reject	Mark
1(d)	$Ca(NO_3)_2.2H_2O \rightarrow CaO + 2NO_2 + \frac{1}{2}O_2 + 2H_2O$ OR Multiples ALLOW $Ca(NO_3)_2.2H_2O \rightarrow CaO + N_2O_4 + \frac{1}{2}O_2 + 2H_2O$ All formulae correct (1) Balancing , conditional on correct formulae (1) IGNORE state symbols even if incorrect		(2)

Question Number	Acceptable Answers	Reject	Mark
1(e)(i)	Calcium hydroxide (solution) / lime water IGNORE Formula $Ca(OH)_2$		(1)

Question Number	Acceptable Answers	Reject	Mark
1(e)(ii)	Carbon dioxide / CO_2		(1)

(Total for Question 1 = 12 marks)
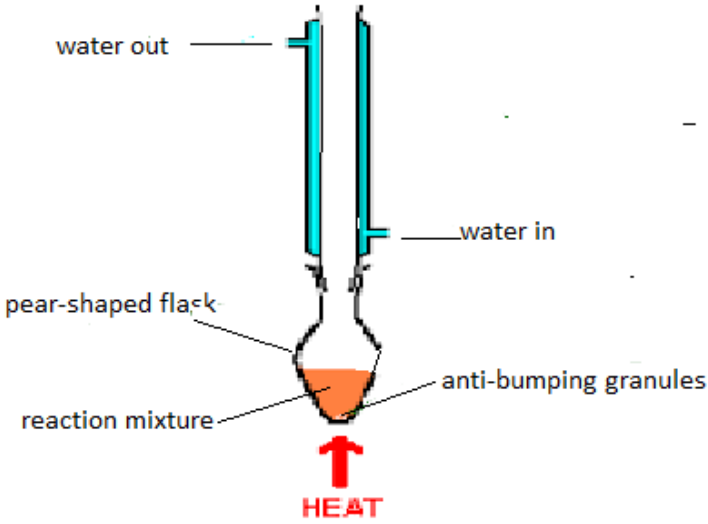
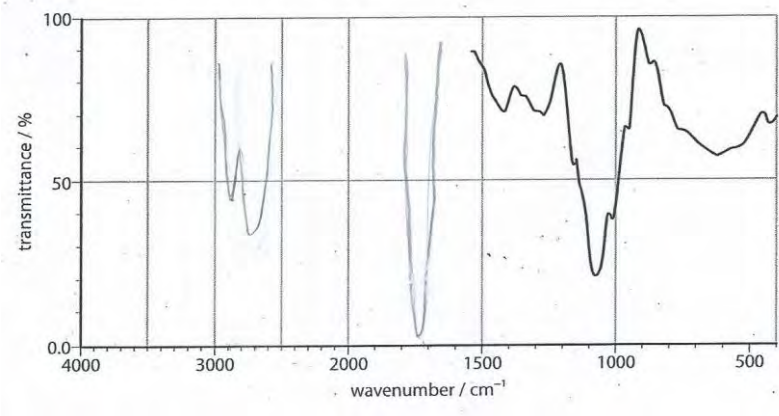| Question Number	Acceptable Answers	Reject	Mark
2(a)	**MP1:** Bromine reaction shows **X** is unsaturated / an alkene / contains C=C (bond) ALLOW Double bond for C=C (1) **MP2:** Mass of 1 mol = (mass of 24.0 dm^3) = (24.0 x 6.00 / 5.14 = 28.016) =**28** (g mol^{-1}) OR (5.14/24.0 = 0.214 6.00/0.214 = 28.016) =**28** (g mol^{-1}) ALLOW (6.00/ 0.21 = 28.57) =**29** (g mol^{-1}) IGNORE unit (1) **MP3:** IGNORE Bond angles Structural formula, skeletal formula C_2H_4 , CH_2CH_2 (1) No TE for propene if answer for MP2 is said to be 42.	30 (g mol^{-1})	**(3)**

Question Number	Acceptable Answers	Reject	Mark
2b(i)	**Test:** Mix with fumes of ammonia / $NH_3((g))$ ALLOW Hold rod dipped in ammonia in the HCl fumes Hold open bottle of ammonia near HCl fumes (Add) ammonia/NH_3 IGNORE Conc/dilute (for ammonia)　　　　(1) **Result:** Depends on use of ammonia / NH_3 White smoke/ powder/ solid ALLOW (Dense) white fumes IGNORE Name / formula of white smoke even if incorrect　　　　(1) OR **Test:** (Mix HCl with) silver nitrate (solution) (+ nitric acid)　　　　(1) **Result:** Depends on use of silver nitrate white precipitate　　　　(1)	Pass HCl into ammonia solution White suspension Misty fumes Steamy fumes	**(2)**

Question Number	Acceptable Answers	Reject	Mark
2b(ii)	**(A molecule of) Y** contains **(−)OH groups** ALLOW hydroxy / hydroxyl OR Carboxylic acid/ COOH groups or alcohol groups 　　　　(1) **MP2 dependent on MP1** **Two** (−OH groups per molecule)　　(1) IGNORE References to primary, secondary or tertiary alcohols "Two −OH groups per molecule" scores 2 "Molecules of Y are diols" scores 2	OH^- (ions)/ hydroxide	**(2)**

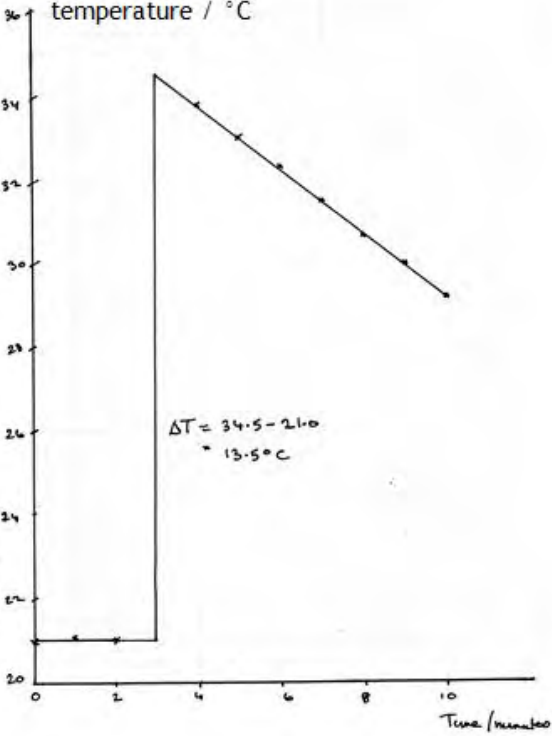| Question Number	Acceptable Answers	Reject	Mark
2b(iii)	Relative molecular mass = **62** This may be answered on the mass spectrum (1) $HOCH_2CH_2OH$ ALLOW displayed formula, skeletal formula (1) IGNORE Point of attachment to OH in formula unless C−H−O/O−H−C is shown horizontally No TE on incorrect Mr		**(2)**

Question Number	Acceptable Answers	Reject	Mark
2b(iv)

Any heat source **and** round bottom / pear shaped flask
ALLOW
just arrow for heat / **hot** water bath   (1)

Correct condenser in vertical position
and
with water entering at bottom and leaving at top

ALLOW
Just arrows for water direction   (1)

IGNORE
Lack of obvious joint between flask and condenser

Condenser open at the top **and** no obvious gaps between condenser and flask   (1)

IGNORE
Horizontal line between flask and condenser

ALLOW
Fully correct distillation apparatus with collecting vessel scores max (2) | Conical flask | (3) |

Question Number	Acceptable Answers	Reject	Mark
2b(v)	(Strong) peaks centred between 1750 – 1700 (cm^{-1}) (C=O stretching in aldehydes) (1) One or two peaks centred between 2950 – 2650 (cm^{-1}) (C-H stretching in aldehydes) (1) IGNORE how peaks are connected in the spectrum unless other definite peaks are shown. Relative intensities of the peaks 		**(2)**

(Total for Question 2 = 14 marks)

Question Number	Acceptable Answers	Reject	Mark
3(a)	Mol $CuSO_4$ = (50.0 x 0.150 / 1000) = **7.50 x 10⁻³ / 0.00750** (1) Mol Mg = (0.250 / 24.3**) = 1.0288 x 10⁻² / 1.03 x 10⁻² / 0.0103/ 0.01** ALLOW Mol Mg = (0.250 / 24**) = 1.04 x 10⁻² / 0.0104** OR Minimum mass Mg to react = (0.00750 x 24 .3**) = 0.182 g OR** (0.00750 x 24) **= 0.18 g** (so Mg is in excess by 0.06775 g / 2.7881 x 10⁻³ mol) (1) IGNORE SF		**(2)**

Question Number	Acceptable Answers	Reject	Mark
3(b)	Blue colour disappears OR red-brown / brown / pink solid appears ALLOW Particles/ precipitate for solid IGNORE Some Mg dissolves Temperature changes Bubbles/ effervescence Red, orange, orange-red for copper	Just "precipitate forms" Black ppt	**(1)**

Question Numer	Acceptable Answers	Reject	Mark
3c

Labelled axes with units, and vertical scale including from 21 to 36 covering more than half of the grid, and correctly plotted points covering more than half the grid. (1)

COMMENT
Correctly plotted points will all lie on a straight line ± half a small square

(Initial line extrapolated forwards to at least 3 minutes and) cooling line extrapolated back to at least 3 minutes
Vertical line is not essential (1)

MP3 dependent on MP2
Temperature at 3 minutes must be used to determine rise
Maximum temperature rise = 13.6°C

ALLOW
13.3-13.8 °C (1) | | **(3)** |

Question Number	Acceptable Answers	Reject	Mark

3(d)	Energy transferred = (50.0 x 4.18 x 13.6)
	    = **2842.4 (J)**
	OR
	    = **2.8424 kJ**
	
	ALLOW
	Any number between 12.8 – 35.3 for temperature rise **IF** no value given for temperature rise given in 3(c)
	
	Use of temperature rise even if maximum temperature, rather than rise is given in 3(c) (1)
	
	IGNORE
	SF except 1 or 2 SF
	Sign, at this stage
	
	ΔH = -(2.8424 / 0.00750)
	    = -378.987 (kJ mol^{-1})
	
	ΔH = **-379 (kJ mol^{-1}) / -379 000 J mol^{-1}**
	
	Value (1)
	
	Sign and 3 SF in final answer (1)
	
	Use of 0.0103 or 0.0104 (mol Mg) instead of 0.00750 (mol Cu) giving -276 kJ mol^{-1} scores MAX 2
	
	ALLOW TE on any maximum temperature
	rise and on mol copper sulfate in (a).
		More or fewer than 3 SF
		Incorrect units
			(3)

Question Number	Acceptable Answers	Reject	Mark
3(e)	(2 x 0.05 /50.0) x100 = (±) **0.20% / 0.2% / 0.200%**		**(1)**

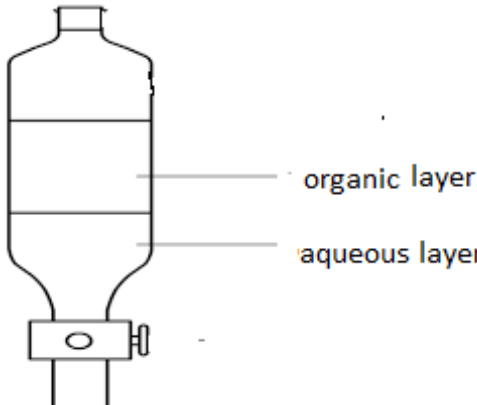| Question Number	Acceptable Answers	Reject	Mark
3(f)	The reaction in both cases is between Cu^{2+}(aq) and Mg/ between the same species OR the sulfate and chloride ions are only spectators /are not involved OR The cation is the same for both reactions IGNORE Same reaction (in both cases) References to energy changes in making and breaking bonds	Between the same ions	**(1)**

(Total for Question 3 = 11 mark)

Question Number	Acceptable Answers	Reject	Mark
4(a)	2-methylpropan-2-ol: flammable / inflammable/ vapour may ignite / ignites easily (1)	Explosive	(2)
	Concentrated HCl: corrosive		
	IGNORE damages eyes/ damages skin / burns skin (1)		

Question Number	Acceptable Answers	Reject	Mark
4(b)	(Shake conical flask + contents and) remove stopper/ loosen stopper /open flask (at intervals)	Put flask into cold Water Turn stopper Change the container	(1)
	IGNORE Use a valve / tap		

Question Number	Acceptable Answers	Reject	Mark
4(c)	So that the flask does not break / explode OR So that the stopper does not pop out OR To allow/ compensate for expansion OR To release vapour / gas OR To release volatile compounds	To release heat	(1)
	ALLOW To prevent explosion		
	IGNORE reaction is exothermic		

Question Number	Acceptable Answers	Reject	Mark
4(d)	Increases the density of the aqueous layer (making it easier to separate)	To absorb water / drying agent	(1)
	ALLOW To aid separation of the layers	To neutralise/react / remove HCl, water, alcohol	

Question Number	Acceptable Answers	Reject	Mark
4(e)	 Funnel of any shape with tap at bottom and narrowing at top / capable of been sealed with a bung (showing the bung is optional) ALLOW Picture of funnel with a horizontal line at the top (as opposed to a cross section diagram) (1) Upper layer labelled organic / 2-chloro-2 methylpropane / halogenoalkane **and** lower layer labelled aqueous / sodium hydrogencarbonate (solution) ALLOW Water layer for aqueous layer (1)	2-methyl propan-2-ol / alcohol	(2)

Question Number	Acceptable Answers	Reject	Mark
4(f)	solution / mixture / liquid is clear ALLOW Goes clear/clearer/less cloudy is transparent/goes transparent		(1)

Question Number	Acceptable Answers	Reject	Mark
4(g)	Lower number in the range of 48 to 50 °C **and** upper number in the range of 52 to 54°C	Any range including 51°C	(1)

Question Number	Acceptable Answers	Reject	Mark

4(h)	**Final answer should be to a minimum of 2 SF. Allow TE at each stage.**
	Ignore SF in intermediate stages (written down or used) except 1 SF.
	Correct final answer with no working scores full marks.
	Final answer will be from 16.5 to 17 depending on rounding.
	
	MP1
	Mass 2-methylpropan-2-ol = (20 x 0.789)
	   = **15.78** g (1)
	
	MP2
	mol 2-methylpropan-2-ol = (15.78 / 74.1)
	   = **0.21296** (1)
	
	MP3
	theoretical mass of
	of 2-chloro-2-methylpropane = (0.21296 x 92.6)
	   = **19.720** g (1)
	
	 MP4
	  actual mass of 2-chloro-2-methylpropane =
	  (19.720 x 0.85)
	   = **16.762** g (1)
	
	  OR for MP3 and MP4
	
	moles of 2-chloro-2-methylpropane =
	(0.21296 x 0.85) = **0.18102** (1)
	
	mass of 2-chloro-2- methylpropane =
	(0.18102 x 92.6) = **16.762** g (1)
	
	ALLOW Final answer using both 74.0 and 92.5 :
	16.76625 g
	
	Final answer using 74.1 and 92.5 :
	16.74398 g
	
	Final answer using 74.0 and 92.6 :
	16.784376
		Rounding at any stage to 1 SF	**(4)**

(Total for Question 4 = 13 marks)