



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 response

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)	<p>EITHER Substance: (anhydrous) cobalt(II) chloride (paper)</p> <p>ALLOW Cobalt chloride/CoCl₂ (1)</p> <p>Colour change: turns from blue to pink (1)</p> <p>OR Substance: (anhydrous) copper(II) sulfate ALLOW copper sulfate/CuSO₄ (1)</p> <p>Colour change: turns from white to blue (1)</p> <p>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)</p>	<p>Boiling temperature is 100°C</p> <p>Test with litmus</p> <p>Test with universal indicator</p>	(2)

Question Number	Acceptable Answers	Reject	Mark
1c(i)	<p>Nitrogen dioxide/nitrogen(IV) oxide/NO₂ and is brown/red-brown/reddish-brown</p> <p>ALLOW dinitrogen tetroxide/N₂O₄ and brown/ red-brown</p>	<p>nitrite ion</p> <p>red</p> <p>other colours</p>	(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 ₂ O → CaO + 2NO ₂ + ½O ₂ + 2H ₂ O OR Multiples ALLOW Ca(NO ₃) ₂ .2H ₂ O → CaO + N ₂ O ₄ + ½O ₂ + 2H ₂ O 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)

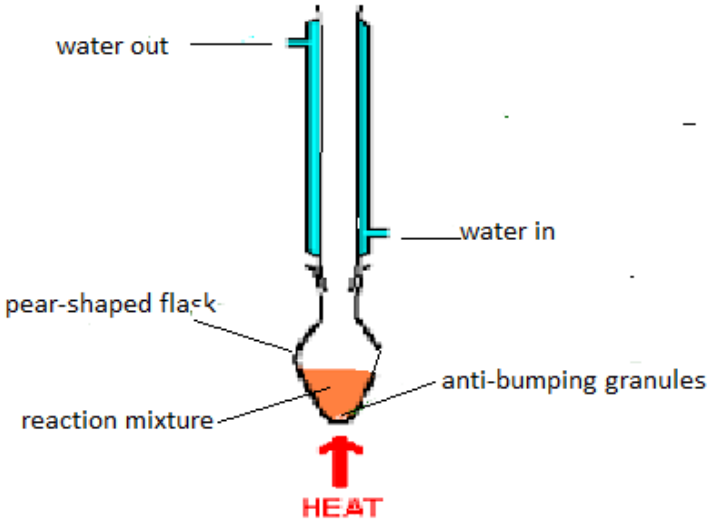
(Total for Question 1 = 12 marks)

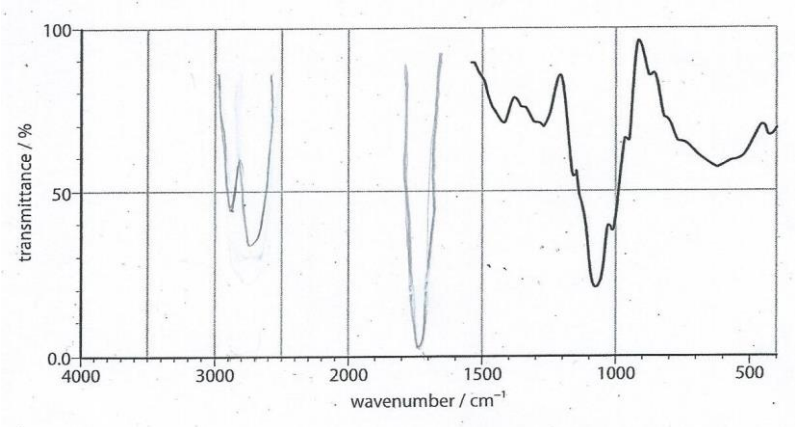
Question Number	Acceptable Answers	Reject	Mark
2(a)	<p>MP1: Bromine reaction shows X is unsaturated / an alkene / contains C=C (bond) ALLOW Double bond for C=C (1)</p> <p>MP2: Mass of 1 mol = (mass of 24.0 dm³) = (24.0 x 6.00 / 5.14 = 28.016) = 28 (g mol⁻¹)</p> <p>OR (5.14/24.0 = 0.214 6.00/0.214 = 28.016) = 28 (g mol⁻¹)</p> <p>ALLOW (6.00/ 0.21 = 28.57) = 29 (g mol⁻¹)</p> <p>IGNORE unit (1)</p> <p>MP3:</p> <pre> H H \ / C = C / \ H H </pre> <p>IGNORE Bond angles Structural formula, skeletal formula C₂H₄, CH₂CH₂ (1)</p> <p>No TE for propene if answer for MP2 is said to be 42.</p>	30 (g mol ⁻¹)	(3)

Question Number	Acceptable Answers	Reject	Mark
2b(i)	<p>Test: Mix with fumes of ammonia / $\text{NH}_3(\text{g})$</p> <p>ALLOW Hold rod dipped in ammonia in the HCl fumes Hold open bottle of ammonia near HCl fumes (Add) ammonia/NH_3</p> <p>IGNORE Conc/dilute (for ammonia) (1)</p> <p>Result: Depends on use of ammonia / NH_3 White smoke/ powder/ solid</p> <p>ALLOW (Dense) white fumes</p> <p>IGNORE Name / formula of white smoke even if incorrect (1) OR</p> <p>Test: (Mix HCl with) silver nitrate (solution) (+ nitric acid) (1)</p> <p>Result: Depends on use of silver nitrate white precipitate (1)</p>	<p>Pass HCl into ammonia solution</p> <p>White suspension Misty fumes Steamy fumes</p>	(2)

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

Question Number	Acceptable Answers	Reject	Mark
2b(iii)	Relative molecular mass = 62 This may be answered on the mass spectrum (1) HOCH ₂ CH ₂ OH 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 <i>Mr</i>		(2)

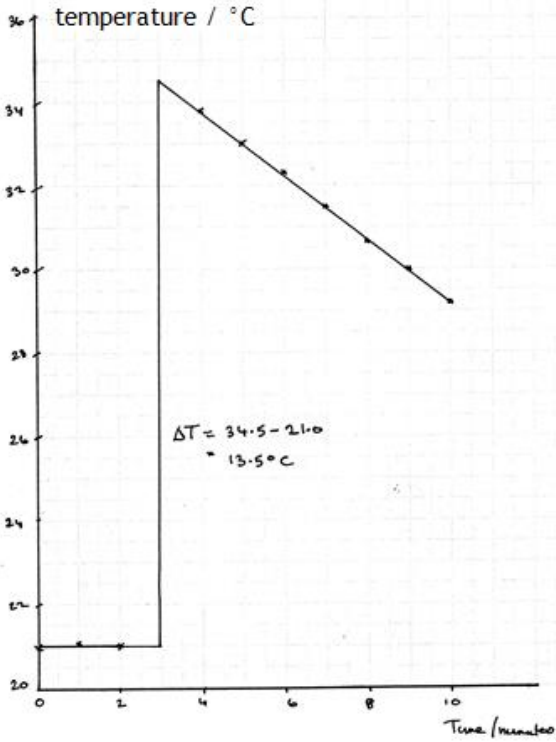
Question Number	Acceptable Answers	Reject	Mark
2b(iv)	 <p>Any heat source and round bottom / pear shaped flask ALLOW just arrow for heat / hot water bath (1)</p> <p>Correct condenser in vertical position and with water entering at bottom and leaving at top ALLOW Just arrows for water direction (1)</p> <p>IGNORE Lack of obvious joint between flask and condenser</p> <p>Condenser open at the top and no obvious gaps between condenser and flask (1)</p> <p>IGNORE Horizontal line between flask and condenser</p> <p>ALLOW Fully correct distillation apparatus with collecting vessel scores max (2)</p>	Conical flask	(3)

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

(Total for Question 2 = 14 marks)

Question Number	Acceptable Answers	Reject	Mark
3(a)	<p>Mol $\text{CuSO}_4 = (50.0 \times 0.150 / 1000) =$ $7.50 \times 10^{-3} / 0.00750$ (1)</p> <p>Mol Mg = $(0.250 / 24.3) =$ $1.0288 \times 10^{-2} / 1.03 \times 10^{-2} /$ $0.0103 / 0.01$</p> <p>ALLOW Mol Mg = $(0.250 / 24) =$ $1.04 \times 10^{-2} / 0.0104$</p> <p>OR Minimum mass Mg to react = (0.00750×24.3) = 0.182 g OR $(0.00750 \times 24) = \mathbf{0.18 \text{ g}}$</p> <p>(so Mg is in excess by $0.06775 \text{ g} /$ $2.7881 \times 10^{-3} \text{ mol}$) (1)</p> <p>IGNORE SF</p>		(2)

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

Question Numer	Acceptable Answers	Reject	Mark
3c	 <p>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)</p> <p>COMMENT Correctly plotted points will all lie on a straight line \pm half a small square</p> <p>(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)</p> <p>MP3 dependent on MP2 Temperature at 3 minutes must be used to determine rise Maximum temperature rise = 13.6°C</p> <p>ALLOW 13.3-13.8 °C (1)</p>		(3)

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

Question Number	Acceptable Answers	Reject	Mark
3(e)	$(2 \times 0.05 / 50.0) \times 100$ = (±) 0.20% / 0.2% / 0.200%		(1)

Question Number	Acceptable Answers	Reject	Mark
3(f)	The reaction in both cases is between $\text{Cu}^{2+}(\text{aq})$ 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)

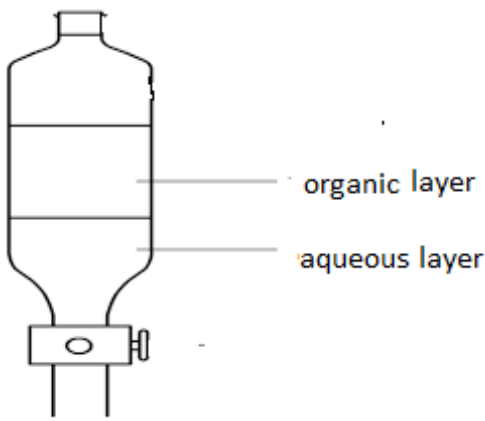
(Total for Question 3 = 11 mark)

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

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

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 ALLOW To prevent explosion IGNORE reaction is exothermic	To release heat	(1)

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

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

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

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

Question Number	Acceptable Answers	Reject	Mark
4(h)	<p>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.</p> <p>MP1 Mass 2-methylpropan-2-ol = (20 x 0.789) = 15.78 g (1)</p> <p>MP2 mol 2-methylpropan-2-ol = (15.78 / 74.1) = 0.21296 (1)</p> <p>MP3 theoretical mass of of 2-chloro-2-methylpropane = (0.21296 x 92.6) = 19.720 g (1)</p> <p>MP4 actual mass of 2-chloro-2-methylpropane = (19.720 x 0.85) = 16.762 g (1)</p> <p>OR for MP3 and MP4</p> <p>moles of 2-chloro-2-methylpropane = (0.21296 x 0.85) = 0.18102 (1)</p> <p>mass of 2-chloro-2- methylpropane = (0.18102 x 92.6) = 16.762 g (1)</p> <p>ALLOW Final answer using both 74.0 and 92.5 : 16.76625 g</p> <p>Final answer using 74.1 and 92.5 : 16.74398 g</p> <p>Final answer using 74.0 and 92.6 : 16.784376</p>	Rounding at any stage to 1 SF	(4)

(Total for Question 4 = 13 marks)