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Mark Scheme (Results)

Summer 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 Answer	Reject	Mark
1(a)(i)	**MP1 and MP2** Dip (clean) nichrome / platinum wire ALLOW NiCr for nichrome loop / rod for wire OR Silica rod (1) in (concentrated) hydrochloric acid / HCl(aq) ALLOW any mention of HCl(aq) e.g. cleaning or mixing solid and acid or making a paste HCl for HCl(aq) (1) IGNORE Dilute ALLOW (for MP1 and MP2) (Wooden) splint (in place of a wire) and Soaked in distilled / deionised water (2) **MP3** then dipped in solid **and** placed in (hot / roaring / blue-cone) (Bunsen) **flame** ALLOW salt / compound / substance / paste / solution for 'solid' On / over / under / near / show / above for 'in' (1) IGNORE inoculating / flame-test (wire)	Nickel / chrome / chromium spatula Other acids Just 'water' Just 'Bunsen'	**(3)**

Question Number	Acceptable Answer	Reject	Mark
1(a)(ii)	K^+ OR Potassium (ion)	K	**(1)**

Question Number	Acceptable Answer	Reject	Mark
1(b)(i)	Carbon dioxide / CO_2		**(1)**

Question Number	Acceptable Answer	Reject	Mark
1(b)(ii)	MP2 dependent on MP1 Cobalt chloride / $CoCl_2$ (paper) (1) Turns (from blue to) pink ALLOW Turns red (1) OR Anhydrous copper(II) sulfate / $CuSO_4$ (1) Turns (from white to) blue (1) ALLOW copper(II) sulfate / $CuSO_4$ (1) Turns from white **and** to blue (1)	Boiling temperature	**(2)**

Question Number	Acceptable Answer	Reject	Mark
1(c)(i)	Hydrogencarbonate / HCO_3^- ALLOW Hydrogen carbonate Bicarbonate potassium hydrogencarbonate / $KHCO_3$	Carbonate / CO_3^{2-}	**(1)**

Question Number	Acceptable Answer	Reject	Mark
1(c)(ii)	$2KHCO_3(s) \rightarrow K_2CO_3(s) + H_2O(l) + CO_2(g)$ Correct species (1) Balanced & states (1) ALLOW $H_2O(g)$ $2KHCO_3(s) \rightarrow K_2O(s) + H_2O(l) + 2CO_2(g)$ scores (1) TE on cation in (a)(ii) If a hydrated Group 2 carbonate or lithium carbonate is used, correct balanced equation scores (1) No TE on a incorrect anion in (c)(i)	Anhydrous carbonate (scores (0))	**(2)**

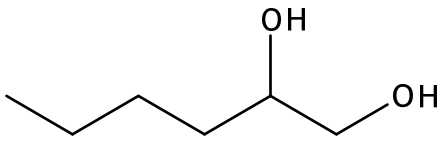
Total for Question 1 = 10 marks

Question Number	Acceptable Answer	Reject	Mark
2(a)	Hexan-1-ol ALLOW Hexane-1-ol / 1-Hexanol If two or more names are given, all must be correct	Hexanol Hexen-1-ol Hexa-1-ol Hex-1-ol	**(1)**

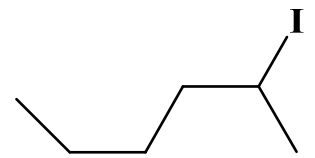
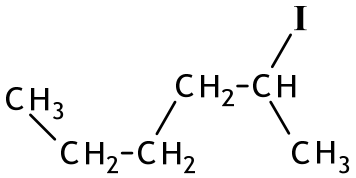
Question Number	Acceptable Answer	Reject	Mark
2(b)	Any test (1) corresponding result (1) MP2 dependent on MP1 **Test** / **Result** Add phosphorus(V) chloride / phosphorus pentachloride / PCl_5 — Steamy / misty / white fumes OR White smoke **and** with ammonia Add thionyl chloride / $SOCl_2$ — Steamy / misty / white fumes Add sodium / Na — Effervescence / bubbling / fizzing IGNORE white solid formed sodium dissolved Add ethanoic acid and a mineral acid and warm — Sweet / fruity / pear drops smell ALLOW PCl_5 solution, unless unsuitable solvent (e.g. water) when max 1 (for result) ALLOW for 1 mark **Acidified** sodium or potassium dichromate((VI)) / $Na_2Cr_2O_7$ / $K_2Cr_2O_7$ turns from orange to green / blue If product is tested, test and result must be fully correct	Phosphorus(III) chloride / phosphorus trichloride / PCl_3 Just smoke Smoke Just $Na_2Cr_2O_7$ / $K_2Cr_2O_7$ (no acid)	**(2)**

Question Number	Acceptable Answer	Reject	Mark
2(c)	MP2 dependent on mention of silver nitrate **First mark** Add (aqueous ethanol solution of) silver nitrate / $AgNO_3$ (and nitric acid) OR Add NaOH, (then) HNO_3 and (followed by) silver nitrate / $AgNO_3$ (1) **Second mark** Yellow precipitate ALLOW Yellow solid / crystals (1) IGNORE Heat Addition of ammonia to precipitate If product is tested, test and result must be fully correct	Other acids Other acids Just 'turns yellow' Tests for iodine (scores (0))	**(2)**

Question Number	Acceptable Answer	Reject	Mark
2(d)(i)	From pink / purple to colourless IGNORE clear dark	Red	**(1)**

Question Number	Acceptable Answer	Reject	Mark
2(d)(ii)	 Penalise bond to OH only when it is clearly to the H atom	Displayed or structural formulae H atoms on carbons of skeletal formula	**(1)**

Question Number	Acceptable Answer	Reject	Mark
2(e)	These are stand alone marks (Reagent=) potassium hydroxide / KOH ALLOW Sodium hydroxide / NaOH (1) (Conditions =) Alcoholic / ethanolic solution **and** heat / boil / reflux / warm (1) If reagent is given as alcoholic KOH / NaOH and conditions as heat, award **both** marks	additional incorrect reagents Distil	**(2)**

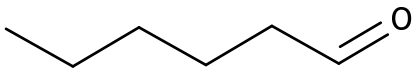
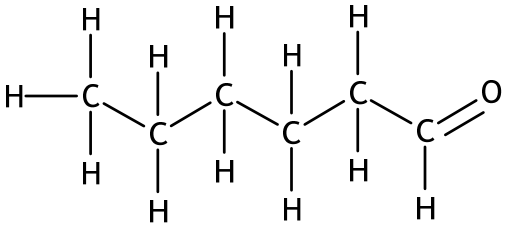
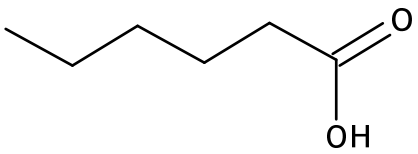
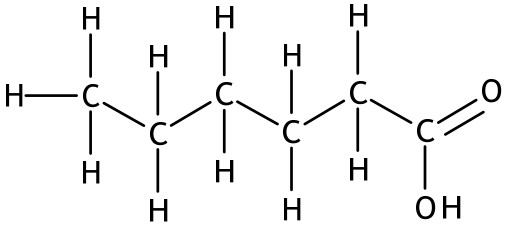
Question Number	Acceptable Answer	Reject	Mark
2(f)(i)	 OR  OR Fully displayed OR $CH_3CH_2CH_2CH_2CHICH_3$		**(1)**

Question Number	Acceptable Answer	Reject	Mark
2(f)(ii)	Secondary **carbocation** (formed in the first step) is more stable (than the primary) (so little F forms) OR Reverse argument Intermediate ions can be shown by structural (or other) formulae IGNORE Reference to Markovnikov's Rule Secondary product is more stable	Just 'intermediate' Just 'structure' cation Just 'carbocation' more stable	**(1)**

Question Number	Acceptable Answer	Reject	Mark
2(g)(i)	Water in bottom & water out top (1) anti-bumping granules ALLOW pieces of porcelain nucleation granules glass beads anti-bumping crystals (1)	Just arrows Anti-knock	**(2)**

Question Number	Acceptable Answer	Reject	Mark
2(g)(ii)	(Heat / boil under) Reflux OR Refluxing ALLOW Reflux condenser	Any distillation Just condensing	**(1)**

Question Number	Acceptable Answer	Reject	Mark
2(g)(iii)	(Cold) **water** (passing through the condenser) (cools and) condenses the vapours /gases (rising from the reaction mixture) ALLOW Description of condensing (1) Prevents escape of reactants and products ALLOW Prevents escape of reactants / products / vapours / gases ALLOW so that the reaction / oxidation can continue to completion (1)		**(2)**

Question Number	Acceptable Answer	Reject	Mark
2(h)(i)	 ALLOW Aldehyde hydrogen shown OR  (1)  OR  (1) Both functional groups displayed and correct, but with errors on carbon chains or structural formulae used for chain scores (1)	-CHO -COH -COOH	**(2)**

Question Number	Acceptable Answer	Reject	Mark
2(h)(ii)	EITHER Aldehyde / CHO **and** carboxylic acid / COOH **groups** will have characteristic peaks / absorptions (at different wavenumbers / frequencies) OR carboxylic acid has an O−H group which absorbs at a particular frequency / O−H peak ALLOW Wavelength for wavenumber / frequency carboxylic acid has an C−O bond which absorbs at a particular frequency Different fingerprint regions IGNORE Reference to carbonyl / C=O group	**Just** reference to the bonds / groups / stretching / bending	**(1)**

Question Number	Acceptable Answer	Reject	Mark
2(i)(i)	Thermometer (1) Stillhead / (3-way) adaptor (1) Conical / Erlenmeyer / collecting flask ALLOW Delivery tube beaker test / boiling tube measuring cylinder round-bottom /pear-shaped flask (1) IGNORE Stopper Side arm tube Vented tube Condenser ALLOW Diagram with appropriate labels	Just 'flask' volumetric flask	**(3)**

Question Number	Acceptable Answer	Reject	Mark
2(i)(ii)	Lower value: any value from 200 to 205(°C) Upper value: any value from 207 to 212(°C)	Single temperature	**(1)**

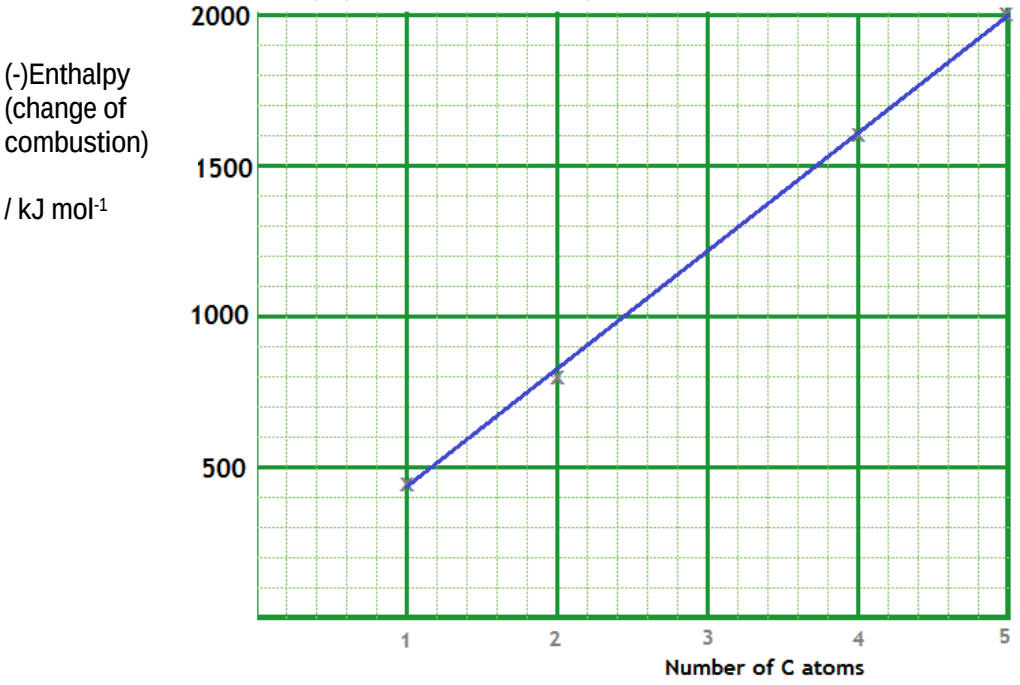
Question Number	Acceptable Answer	Reject	Mark
2(i)(iii)	(anhydrous) Calcium chloride / $CaCl_2$ OR Magnesium sulfate / $MgSO_4$ OR Sodium sulfate / Na_2SO_4 ALLOW Calcium sulfate / $CaSO_4$ If name & formula **both** must be correct	Sulfuric acid / H_2SO_4 $CuSO_4$ $CuCl_2$ Silica gel	**(1)**

Total for Question 2 = 24 marks

Question Number	Acceptable Answer	Reject	Mark
3(a)(i)	E = [(0.39 x 300) + (4.2 x 400)] x 12 (1) = 21564 (J) / 21.564 **kJ** (ans*) TE on incorrect **values** in expression ALLOW for MP2 20277(J) / 20.277 **kJ** (1) IGNORE SF except 1 SF IGNORE sign Correct answer with no working scores (2)		**(2)**

Question Number	Acceptable Answer	Reject	Mark
3(a)(ii)	M_r (CH_3OH) = 32 Amount methanol = 1.65/32 (ans**) (1) (= 0.05156) ΔH_c = −ans* / ans** = −21564 x 32 / 1.65 = −418211 **J mol^{-1}** = **−**418 (kJ mol^{-1}) If 20277 used ΔH_c = **−**393251 **J mol^{-1}** = **−**393 (kJ mol^{-1}) Value (1) Correct sign and units (if given) (1) TE on any value obtained in (a)(i) TE on **correctly** rounded values from (a)(i) IGNORE SF except 1 SF Correct answer with no working scores (3) If units are given for the final answer they must be fully correct	use of values rounded to 1 SF	**(3)**

Question Number	Acceptable Answer	Reject	Mark
3(b)(i)	See graph below Axes labelled including units and scale as shown or similar (1) All four points correct **and** best fit line drawn TE on axes reversed (1) ALLOW ΔH_c label with units on y-axis Graph plotted with negative enthalpy changes Formulae of alcohols on the intervals of the x-axis with or without axis label IGNORE Omission of negative sign before enthalpy of combustion Extrapolation	scale that does not use top ¼ and / or right-hand $^3/_{10}$ of the grid non-linear scales scores zero	**(2)**



Question Number	Acceptable Answer	Reject	Mark
3(b)(ii)	This mark is stand alone (−)1200±50 (kJ mol^{-1}) IGNORE omission of negative sign If units are given they must be fully correct No TE on incorrect graph		**(1)**

Question Number	Acceptable Answer	Reject	Mark
3(b)(iii)	**Marking Point 1** For each successive alcohol 1 extra C−C bond and 2 extra C−H bonds and $^3/_2$ extra O=O bonds have to be broken and 2 extra C=O bonds and 2 extra O−H bonds are formed OR The same **extra** bonds are broken and formed on each increment ALLOW As the chain length increases more bonds need to be broken but more bonds are formed. OR Each successive alcohol has an extra CH_2 group OR Each successive alcohol has two extra C-H bonds and one extra C-C bond (1) **Marking Point 2** Breaking (C−C and C−H) bonds is endothermic / requires energy **and** forming (C=O and O−H) bonds is exothermic /releases energy (1) If intermolecular forces used at any point as an explanation, max (1)		**(2)**

Question Number	Acceptable Answer	Reject	Mark
3(c)(i)	Correct answer with no working scores (2) % Error = 100 x (1367.3 – 800) / 1367.3 (1) = 41.4905 = 41% (1) TE for SF only on use of 800 as denominator (error = 71% (to 2SF)) IGNORE Use of negative signs on enthalpy changes (–1367.3 & –800) ± in front of answer Answer greater than 100% score zero	= 41.5 = 42%	**(2)**

Question Number	Acceptable Answer	Reject	Mark
3(c)(ii)	I. The % uncertainties in the thermometer and balance readings are very small (compared with the difference between the student mean and the Data Book value) OR The thermometer and balance reading uncertainties are random and would give values both high and low rather than consistently low II. The rounding of the specific heat capacities is small (compared with the observed differences) OR Both specific heat capacities have been rounded up so would produce larger magnitude / more negative values for the enthalpies III. Heat losses will be large…. despite the draught shield OR from flame or calorimeter or water OR because the copper can is not / should be insulated OR because the copper can does not / should have (loose fitting) lid IV. Incomplete combustion will cause significant error as there will be insufficient oxygen ALLOW 1 mark in place of **either** III **or** IV for Heat loss / incomplete combustion will result in lower magnitude / less negative enthalpy change of combustion values ALLOW Reverse arguments	Just 'valid' OR Just 'invalid' Just 'larger' Use of polystyrene cup Just 'lower'	**(4)**

Total for Question 3 = 16 marks

Total for Paper = 50 marks

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