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Mark Scheme (Results)

Summer 2017

Pearson Edexcel IAL
In Chemistry (WCH03) Paper 01
Chemistry Laboratory Skills I



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Summer 2017
Publications Code WCH03_01_1706_MS
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General marking guidance

- This mark scheme provides a list of acceptable answers for this paper. Candidates will receive credit for all correct responses but will be penalised if they give more than one answer where only one is required (e.g. putting an additional cross in a set of boxes). If a candidate produces more written answers than the required number (two instead of one, three instead of two etc), only the first answers will be accepted. Free responses are marked for the effective communication of the correct answer rather than for quality of language but it is possible that, on some occasions, the quality of English or poor presentation can impede communication and loose candidate marks. It is sometimes possible for a candidate to produce a written response that does not feature in the mark scheme but which is nevertheless correct. If this were to occur, an examiner would, of course, give full credit to that answer.

- 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.

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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.

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Question Number	Acceptable Answers	Reject	Mark
1(a)(i)	$K^+/K^{+1}/K^{1+}$ IGNORE 'potassium (ion)'	**Just** K	(1)

Question Number	Acceptable Answers	Reject	Mark
1(a)(ii)	Oxygen / O_2 **(1)** KNO_3 IGNORE Name/potassium nitrate ALLOW $KClO_3$ / $KMnO_4$ / KO_2 / K_2O_2 ALLOW TE on cation identified in (a)(i) **(1)** **Mark independently**	 K_2O/KO	(2)

Question Number	Acceptable Answers	Reject	Mark
1(b)(i)	Carbon dioxide / CO_2 **(1)** H^+ / H_3O^+ **(1)** IGNORE 'hydrogen'	 **Just** H, **just** H_3O CO_3^{2-} H^+ / H_3O^+ with any anions	(2)

Question Number	Acceptable Answers	Reject	Mark
1(b)(ii)	If name and formula are given both must be correct Barium sulfate / $BaSO_4$ **(1)** Sulfuric acid / H_2SO_4 **(1)** **ALLOW** $NaHSO_4$ / $KHSO_4$		(2)

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Question Number	Acceptable Answers	Reject	Mark
1(c)	(With bromine water) (From) yellow / orange / brown / red-brown **(1)** (To) colourless / decolourised **(1)** (With PCl_5) Steamy fumes / white fumes / misty fumes **(1)** IGNORE HCl is formed (Blue litmus paper turns) red **(1)** (Solution turns from) orange **(1)** To green ALLOW blue **(1)** **Mark all 6 points independently**	 **Just** red **Just** 'clear' White solid / white smoke Pink / bleached	**(6)**

(Total for Question 1 = 13 marks)

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Question Number	Acceptable Answers	Reject	Mark
2(a)	(Diagram 1) (Heat under) reflux (condenser) / refluxing **(1)** (Diagram 2) (simple) distillation / distilling **(1)**	Fractional distillation / fractionation	**(2)**

Question Number	Acceptable Answers	Reject	Mark
2(b)(i)	Boiling / vaporising / evaporating (in the flask) / liquid to vapour/gas **and** (then) condensing (in the condenser) / vapour/gas back to liquid	**solid** to gas **aqueous** state to gas 'It turns to gas'	**(1)**

Question Number	Acceptable Answers	Reject	Mark
2(b)(ii)	Reaction is slow OR time is needed for reaction to reach completion OR to ensure complete reaction OR to ensure that all reactants are converted (into products) OR to obtain maximum/high yield IGNORE Any reference to activation energy	To ensure that the desired product is obtained Any reference to oxidation	**(1)**

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Question Number	Acceptable Answers	Reject	Mark
2(c)(i)	Two layers shown with the upper layer 'aqueous' OR 'water' **and** lower layer 1-bromobutane / organic layer ALLOW Only one layer correctly labelled IGNORE Relative volumes of each layer	No upper boundary for the aqueous layer	**(1)**

Question Number	Acceptable Answers	Reject	Mark
2(c)(ii)	(The acid protonates butan-1-ol) forming an **ionic** species (that is much more soluble in water/hydrochloric acid than the alcohol itself)	**Just** 'butan-1-ol more soluble in acid than water'	**(1)**

Question Number	Acceptable Answers	Reject	Mark
2(c)(iii)	As a drying agent / to dry the 1-bromobutane / to remove/absorb (traces of) water ALLOW Moisture in place of water	Dehydrating agent	**(1)**

Question Number	Acceptable Answers	Reject	Mark
2(c)(iv)	Turns (from cloudy to) clear / stops being cloudy / cloudiness disappears / no longer turbid	Calcium chloride becomes clear	**(1)**

Question Number	Acceptable Answers	Reject	Mark
2(d)(i)	V (= 14.80 ÷ 0.81 = 18.2716) = 18.3 (cm^3) If units given they must be correct IGNORE SF except 1 SF	cm^{-3}	**(1)**

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Question Number	Acceptable Answers	Reject	Mark
2(d)(ii)	V (= 14.80 ÷ 74 = 0.200) = 0.2(00) (mol)		**(1)**

Question Number	Acceptable Answers	Reject	Mark
2(d)(iii)	Mass (= 0.2(00) x 137) = 27.40 (g) TE from (d)(i) and/or (d)(ii) IGNORE SF except 1 SF		**(1)**

Question Number	Acceptable Answers	Reject	Mark
2(d)(iv)	$\frac{17.81}{27.40}$ x 100% = 65(%) TE on (d)(iii), unless the yield > 100% IGNORE SF except 1 SF		**(1)**

Question Number	Acceptable Answers	Reject	Mark
2(e)	Any TWO from • Competing/side reactions OR formation of by-products • Incomplete reaction • Product lost in purification • Product lost in transfers / product lost when using separating funnel • filter paper absorbs some product • Br^-/HBr gets oxidised by H_2SO_4 ALLOW 'Equilibrium reaction' **(2)** IGNORE Spillage Human error / lack of precise equipment Balance error Measurement error	Not all of the **1-bromobutane** reacts Incomplete oxidation Loss during refluxing	**(2)**

(Total for Question 2 = 14 marks)

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Question Number	Acceptable Answers	Reject	Mark
3(a)	Density of water = 1(.0) g cm^{-3} OR 1(.0) g/cm^3 OR 1(.0) g per cm^3 ALLOW 1(.0) g ml^{-1} OR 1 cm^3/ml of water has a mass of 1g OR ALLOW 1cm^3 equals 1g	Incorrect units 200 cm^3 weighs 200 g Mass = volume	**(1)**

Question Number	Acceptable Answers	Reject	Mark
3(b)(i)	(Energy released = 200 x 4.18 x 24.5) = 20482 (J) IGNORE SF except 1 SF Sign (+ or -) in front of value ALLOW 20.482 **kJ**		**(1)**

Question Number	Acceptable Answers	Reject	Mark
3(b)(ii)	(Moles CH_3OH = 1.09 ÷ 32.0) = 0.0340625 (mol) = 0.0341 (mol) IGNORE SF except 1 SF NOTE 1.09 X 32.0 = 34.88		**(1)**

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Question Number	Acceptable Answers	Reject	Mark
3(b)(iii)	Correct final answer with correct sign, units and SF with or without working scores **(3)** −20.482 ÷0.0341 = −601.306422 (kJ mol^{-1}) = −601 kJ mol^{-1}(3SF) −600 kJ mol^{-1} (2SF) Value will depend on number of sig figs used in answers for (b)(i) and (b)(ii) E.g. −602 comes from using 0.034 TE on (b)(i) and b(ii) **1st mark** Answer to ((b)(i) ÷ (b)(ii)) / 1000 **2nd mark** Minus sign **and** answer in kJ mol^{-1} / kJ/mol ALLOW Minus sign **and** answer in J mol^{-1} / J/mol **3rd mark** Final answer given to 2 SF or 3 SF		**(3)**

Question Number	Acceptable Answers	Reject	Mark
3(c)(i)	(±)$\frac{1.0}{24.5}$ x 100% = 4.08163 = (±)4.08(%) IGNORE SF	 °C	**(1)**

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Question Number	Acceptable Answers	Reject	Mark
3(c)(ii)	(24.5 + 1.0 =) 25.5(^{O}C) OR (46.0 – 20.5 =) 25.5(^{O}C) OR (24.5 x $\frac{104.08}{100}$ =) 25.5(^{O}C)		**(1)**

uestion Number	Acceptable Answers	Reject	Mark
3(d)(i)	**Evaporation/vaporisation** (of methanol / alcohol) ALLOW a description of the **liquid** turning into a **gas**	**Just** "methanol is volatile"	**(1)**

Question Number	Acceptable Answers	Reject	Mark
3(d)(ii)	Carbon / soot	Any other additional substances with the correct answer. e.g. soot and CO	**(1)**

Question Number	Acceptable Answers	Reject	Mark
3(d)(iii)	Incomplete **combustion**/**oxidation** Insufficient oxygen so that the reaction does not go to completion less CO_2 produced so fewer (v. strong) C=O bonds formed **ALLOW** layer of soot insulates the water from the flame / layer of soot absorbs heat	Incomplete reaction	**(1)**

(Total for Question 3 = 11 marks)

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Question Number	Acceptable Answers	Reject	Mark
4(a)(i)	✓ beneath all three titres **and** (22.90 + 22.85 + 22.95) ÷ 3 = 22.9(0) (cm^3)		**(1)**

Question Number	Acceptable Answers	Reject	Mark
4(a)(ii)	(0.100 x 22.90 ÷ 1000) = 2.29 x 10^{-3} / 0.00229 (mol) TE on (a)(i) IGNORE SF except 1SF		**(1)**

Question Number	Acceptable Answers	Reject	Mark
4(a)(iii)	Moles CH_3COOH in 25.0 cm^3 diluted solution = 2.29 x 10^{-3} / 0.00229 (mol) Any mention of the value in (a)(ii) scores this mark **(1)** Moles CH_3COOH in 25.0 cm^3 undiluted solution = 2.29 x 10^{-2} / 0.0229 (mol) TE on (a)(ii) x $\frac{250}{25.0}$ **(1)** NOTE 2.29 x 10^{-2} / 0.0229 (mol) with or without working scores **(2)**		**(2)**

Question Number	Acceptable Answers	Reject	Mark
4(a)(iv)	(2.29 x 10^{-2} / 0.0229 ÷ 0.0250) = 0.916 (mol dm^{-3}) TE on (a)(iii) ie (a)(iii) x ($^{1000}/_{25.0}$)		**(1)**

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Question Number	Acceptable Answers	Reject	Mark
4(a)(v)	Correct final answer with 3SF with or without working scores 3 **1st mark:** M_r (CH_3COOH) = 60(.0) (g mol^{-1}) Any mention of "60" or numbers adding to 60 scores M1 **(1)** **2nd mark:** 0.916 x 60(.0) = 54.96 (g dm^{-3}) TE Answer to (a)(iv) x 60(.0) **(1)** **3rd mark:** = 55.0 (g dm^{-3}) Units not required, but if wrong, do not award M3 TE Answer rounded correctly to 3 SF **(1)** **M3 dependent on M2 unless M2 lost through calculator error**	Just 55 (g dm^{-3}) for 3rd mark	**(3)**

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Question Number	Acceptable Answers	Reject	Mark
4(b)	**1st mark:** Dilute vinegar removes any water / other contaminants (present in pipette) / to ensure that pipette only contains vinegar ALLOW To clean the pipette **(1)** IGNORE Any references to accuracy **2nd mark:** Water (left in pipette) would dilute vinegar / acid ALLOW Any reference to concentration being decreased / changed OR titre value decreased **(1)**	Just 'Will affect the titre value'	**(2)**

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Question Number	Acceptable Answers	Reject	Mark
4(c)	**1st mark:** (Titre) greater / too high/more/larger **(1)** IGNORE Any references to accuracy **2nd mark:** More moles in a certain volume of **acid**/**vinegar** / more moles in the pipette / more moles of acid/vinegar transferred to conical flask ALLOW Just 'more acid' Stated pipette volume does not include quantity left in the tip **(1)** **M2 dependent on M1**		**(2)**

(Total for Question 4 = 12 marks)

TOTAL FOR PAPER = 50 MARKS

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