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Mark Scheme (Results)

January 2024

Pearson Edexcel International Advanced Subsidiary Level in Chemistry (WCH13)
Paper 01 Practical Skills in Chemistry 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.

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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	Additional Guidance	Mark
1(a)	An answer that makes reference to the following points: • (Functional group 1) ketone **(1)** • (Functional group 2) alkene **(1)** • (Functional group 3) (secondary) alcohol **(1)**	Allow alkanones Ignore carbonyl compound Do not award aldehyde Ignore carbon – carbon double bond Do not award alkyl Allow hydroxy / hydroxyl Do not award hydroxide Do not award primary / tertiary Ignore cyclo / aliphatic / aromatic in M1 to M3 Ignore any formulae Allow names shown on the diagram for M1 to M3	**(3)**

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Question Number	Acceptable Answers	Additional Guidance	Mark
1(b)	An answer that makes reference to the following points: • Functional group 2 / alkene Test – (add) bromine water / $Br_2(aq)$ **(1)** Result – (turns from orange to) colourless / (yellow to) colourless **(1)** • Functional Group 3 / 2° alcohol EITHER Test – (add) PCl_5 / phosphorus pentachloride / phosphorus(V) pentachloride **(1)** Result – steamy / misty fumes **(1)** OR Test – (add) Na **(1)** Result - Bubbles (of colourless gas) **(1)** Comment – ignore reference to products in Na test even if incorrect	**M2 dependent on M1 or near miss** – e.g. omission of 'acidified' for dichromate(VI) test means M1 cannot be awarded, but M2 is still available. Allow bromine / Br_2 Allow (brown to) colourless / (brown-red to) colourless Allow just decolourises Do not award incorrect initial colour e.g. red to colourless Allow Test - add acidified $KMnO_4$ / (potassium) manganate ((VII)) (1) Result – (turns from purple/pink to) colourless/decolourises (1) Allow (add) $SOCl_2$/PCl_3 Allow white fumes / fumes that turn indicator paper red / fumes that form white smoke with NH_3 Allow gas / vapour as alternative to fumes Ignore references to HCl Ignore white smoke without reference to NH_3 Allow Test – (add) acidified dichromate ((VI)) Result - orange to green Allow Test (add) carboxylic acid and H^+ and warm/heat Result - fruity smell	**(4)**

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Question Number	Acceptable Answers	Additional Guidance	Mark
1(c)(i)	An answer that makes reference to the following point: • 96 / ninety-six	Ignore any formulae	**(1)**

Question Number	Acceptable Answers	Additional Guidance	Mark
1(c)(ii)	An answer that makes reference to the following point: • (free) radical	Allow R$^{\bullet}$ Allow 'particle with an unpaired electron'	**(1)**

(Total for Question 1 = 9 marks)

Question Number	Acceptable Answers	Additional Guidance	Mark
2(a)	An answer that makes reference to the following points: • both '24.30' **and** '24.20' circled	Allow other forms of indication e.g. use of asterisks / underlining / circling of '1' and '3' in titration header Do not award any other values	**(1)**

Titration	Rough	1	2	3
Burette reading (final) / cm^3	24.60	48.90	23.80	48.00
Burette reading (initial) / cm^3	0.00	24.60	0.00	23.80
Titre / cm^3	24.60	24.30	23.80	24.20

Question Number	Acceptable Answers	Additional Guidance	Mark
2(b)	• calculation of mean from titres 1 and 3 to 4 SF (even if not circled)	<u>Example of calculation</u> (24.30 + 24.20) ÷ 2 = 24.25 (cm^3) Accept 0.02425 dm^3 Allow TE from (a) provided they are calculating the mean of more than one circled titre	**(1)**

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Question Number	Acceptable Answers	Additional Guidance	Mark
2(c)(i)	An answer that makes reference to the following point: • colourless to (pale) pink	Do not award colourless to purple	**(1)**

Question Number	Acceptable Answers	Additional Guidance	Mark
2(c)(ii)	• calculation of the amount of NaOH (in mol) **(1)** • calculation of moles of citric acid in 25 cm^3 of diluted lemon juice **(1)** • calculation of moles of citric acid in 250 cm^3 of diluted lemon juice **(1)** • calculation of mass of citric acid **(1)** • calculation of percentage by mass of citric acid in lemon juice **and** to **2 SF** **(1)**	Example of calculation Ignore rounding errors in M1 to M4 Ignore SF in M1 to M4 unless 1SF $(24.25 \div 1000) \times 0.103 = 2.4978 \times 10^{-3}$ /0.0024978 (mol) Allow TE from (b) $2.4978 \times 10^{-4} \div 3 = 8.3258 \times 10^{-4}$ /0.00083258 (mol) $8.3258 \times 10^{-4} \times 10 = 8.3258 \times 10^{-3}$ /0.0083258 (mol) $8.3258 \times 10^{-3} \times 192 = 1.5986$ (g) M1, M2, M3 and M4 can be in any order $((1.5986 \div 24) \times 100 = 6.6608\ \% =$) 6.7 (%) Correct answer scores 5 marks Allow TE from M4 if answer is less than 100% Ignore units in intermediate stages even if incorrect	**(5)**

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Question Number	Acceptable Answers	Additional Guidance	Mark
2(d)	An answer that makes reference to the following point: • the other acids are present in (very) small amounts (in lemon juice, so will have little effect on the titre values)	Allow 'citric acid has a much greater concentration' Allow 'the other acids are present in much smaller amounts' Ignore just 'the other acids are present in smaller amounts' Ignore comments related to pH / acid strength	**(1)**

Question Number	Acceptable Answers	Additional Guidance	Mark
2(e)(i)	An answer that makes reference to the following point: • (pour away solution, rinse flask and) make a new / fresh solution (of diluted lemon juice)	Allow start again (from the beginning) / repeat the procedure / do the experiment again Allow transfer to larger (volumetric) flask, (rinse) and make up to volume	**(1)**

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Question Number	Acceptable Answers	Additional Guidance	Mark
2(e)(ii)	An answer that makes reference to the following points: • because some water has evaporated **(1)** • (mean NaOH) titre would be lower (as NaOH (aq) is more concentrated) **(1)** OR • NaOH (reacts with CO_2 to) form Na_2CO_3 / $NaHCO_3$ **(1)** • which also reacts with the acid, so will not affect the titre / which results in a less sharp end point **(1)** OR • because NaOH reacts with CO_2 (in the air) **(1)** • (mean) titre would be greater (as NaOH (aq) is less concentrated) **(1)**	**M2 dependent on M1** Allow water has escaped / been lost Allow some of the solution may have evaporated Do not award some of the NaOH (solution) has evaporated Comment If no other mark is awarded allow 'the bottle is sealed so the titre would not be different' for 1 mark	**(2)**

(Total for Question 2 = 12 marks)

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Question Number	Acceptable Answers	Additional Guidance	Mark
3(a)	An answer that makes reference to the following point: • the compounds containing iodine are ionically bonded Comment 'It' or 'they' can be assumed to refer to the compounds containing iodine	Allow the compounds containing iodine do not contain hydrogen / carbon Allow iodine present as iodide ions Ignore iodine compounds are inorganic / not organic Allow the compounds containing iodine have high(er) boiling temperatures (so do not vaporise readily) Ignore references to bond energy / solubility in water / intermolecular forces / melting point Do not award iodine has a high boiling temperature	**(1)**

Question Number	Acceptable Answers	Additional Guidance	Mark
3(b)	• calculation of moles of oxygen produced by 1 dm^3 of hydrogen peroxide solution **(1)** • calculation of concentration of hydrogen peroxide **(1)**	<u>Example of calculation</u> $20 \div 24 = 0.83333/8.3333 \times 10^{-1}$ (mol) $(0.83333 \times 2) = 1.6667 = 1.67$ (mol dm^{-3}) Allow TE from M1 to M2 Ignore SF except 1 SF Ignore minor slips in units e.g. mol dm^3 or mol/dm^{-3} Do not award major unit errors in M2 e.g. g or dm^3 mol^{-1}	**(2)**

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Question Number	Acceptable Answers	Additional Guidance	Mark
3(c)(i)	An answer that makes reference to the following points: • (Oxidation of iodide ions) $2I^- \rightarrow I_2 + 2e^{(-)}$ **(1)** • (Reduction of hydrogen peroxide under acidic conditions) $H_2O_2 + 2H^+ + 2e^{(-)} \rightarrow 2H_2O$ **(1)**	Allow multiples Accept $2I^- - 2e^{(-)} \rightarrow I_2$ Allow $2H^+$ above arrow Ignore state symbols even if incorrect	**(2)**

Question Number	Acceptable Answers	Additional Guidance	Mark
3(c)(ii)	An answer that makes reference to the following point: • $H_2O_2 + 2H^+ + 2I^- \rightarrow 2H_2O + I_2$	Allow multiples Allow $2H^+$ above arrow Allow 2HI Ignore state symbols even if incorrect	**(1)**

Question Number	Acceptable Answers	Additional Guidance	Mark
3(c)(iii)	An answer that makes reference to the following point: • yellow / brown (solution)	Ignore adjectives e.g. 'pale' Do not award orange / purple / blue / black / red / pink / red-brown Do not award precipitate / ppt / solid / crystals Do not award vapour / gas / fumes	**(1)**

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Question Number	Acceptable Answers	Additional Guidance	Mark
3(d)	An answer that makes reference to the following points: • add (aqueous) filtrate / iodine (solution) / mixture to (separating funnel containing) cyclohexane **(1)** • (gently) shake / invert separating funnel **(1)** • open tap of (inverted) separating funnel occasionally to relieve pressure / release gas **(1)** • (allow layers to settle) and then remove (lower) aqueous / inorganic layer **(1)**	Allow addition of liquids to separating funnel in any order Ignore minor slips with name of solvent e.g. cyclohexene / hexane / cyclohexanol Allow idea of mixing / swirling contents Ignore stirring Accept loosen/remove stopper (slightly) to relieve pressure / release gas Ignore references to drying agents / Na_2CO_3 / $NaHCO_3$ Allow removal of the lower layer if it is clear that it is **not** the cyclohexane layer Allow run off the water layer Ignore any references to colours Ignore subsequent attempts to remove iodine from cyclohexane Do not award removal of cyclohexane before aqueous layer M1 to M4 could be shown on an annotated diagram	**(4)**

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Question Number	Acceptable Answers	Additional Guidance	Mark
3(e)(i)	An answer that makes reference to the following point: • (serious) health hazard	Accept hazard to health Allow can cause serious health damage Ignore risk to health / specific conditions e.g. damage to lungs / causes respiratory problems Do not award toxic / corrosive / explosive	**(1)**

Question Number	Acceptable Answers	Additional Guidance	Mark
3(e)(ii)	An answer that makes reference to the following points: • carry out in fume cupboard **(1)** • avoid contact with (naked) flames / sources of ignition **(1)**	Allow carry out in a well-ventilated room Ignore wear goggles, gloves, lab coats and masks Ignore use small amount (of cyclohexane) Allow don't put near fire / don't use near a Bunsen (burner) / don't put near flame Ignore keep away from heat / use of an electric heater / water bath	**(2)**

(Total for Question 3 = 14 marks)

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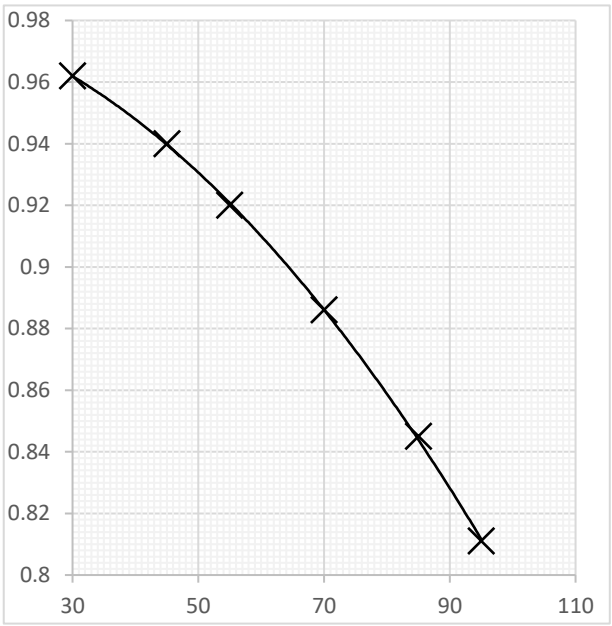
Question Number	Acceptable Answers	Additional Guidance	Mark
4(a)(i)	• calculation of density of ethanol-water mixture sample A	Example of calculation 4.75 ÷ 5.00 = 0.95(0) (g cm^{-3}) Ignore units even if incorrect Allow 950 g dm^{-3}	**(1)**

Question Number	Acceptable Answers	Additional Guidance	Mark
4(a)(ii)	An answer that makes reference to the following points: • suitable linear scale with points covering at least half the available space in both directions **(1)** • all points plotted accurately within ± ½ a square **(1)** • suitable **curve** of best fit **(1)**		**(3)**

Question Number	Acceptable Answers	Additional Guidance	Mark
4(a)(iii)	An answer that makes reference to the following point: • answer from (a)(i) used to determine percentage with evidence shown on graph Comment evidence could be horizontal and / or vertical line OR additional point plotted at density from (a)(i)	38.5 (%) Answer must be consistent with their line on graph ± ½ a square Allow TE from straight line graph Ignore units even if incorrect	**(1)**

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Question Number	Acceptable Answers	Additional Guidance	Mark
4(b)(i)	An explanation that makes reference to the following points: • (distillation allows) removal of ethanal / aldehyde /product (as it forms) **(1)** • to prevent formation of a carboxylic acid / ethanoic acid **(1)**	Allow ethanal can be distilled off / distilled out Allow aldehyde is separated Ignore just distillation Allow heating under reflux forms a carboxylic acid Allow to prevent **further** oxidation Allow it is **only** oxidised to an aldehyde Do not award to prevent formation of / further oxidation to a **ketone**	**(2)**

Question Number	Acceptable Answers	Additional Guidance	Mark
4(b)(ii)	An explanation that makes reference to the following points: • prevents (formation of) air gaps / bubbles / air spaces **(1)** • (so more) efficient cooling results **(1)**	Allow so water fills it / condenser Allow maximum cooling / faster cooling / better cooling Allow as bubbles reduce the cooling effect Ignore references to condensing	**(2)**

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Question Number	Acceptable Answers	Additional Guidance	Mark
4(c)(i)	• calculation of energy transferred to water	Example of calculation (100 × 4.18 × (57.9 – 20.0)) = 15842.2 (J) Allow 15.842 kJ Ignore SF except 1 SF Ignore any positive or negative signs	(1)
Question Number	**Acceptable Answers**	**Additional Guidance**	**Mark**
4(c)(ii)	• calculation of amount of ethanol burnt in mol	Example of calculation (0.650 ÷ 46.0 =) 0.014130 / 1.4130 × 10^{-2} / 14.130 × 10^{-3} (mol) Ignore SF except 1SF	(1)
Question Number	**Acceptable Answers**	**Additional Guidance**	**Mark**
4(c)(iii)	• calculate the enthalpy change of combustion of ethanol in kJ mol^{-1} **and** negative sign **and** 3SF or 2SF	Example of calculation (15.8422 ÷ 0.014130 = (–) 1121.2) = – 1120/1100 (kJ mol^{-1}) Allow TE from (c)(i) and (c)(ii) Allow answer consistent with rounded value from (c)(ii) e.g. use of 0.014 gives – 1131.585 = – 1130 (kJ mol^{-1}) Allow –1120 000 / – 1100 000 J mol^{-1}	(1)
Question Number	**Acceptable Answers**	**Additional Guidance**	**Mark**
4(d)	An explanation that makes reference to the following points: • as copper coil conducts heat from emissions / waste gases / hot gases into water **(1)**	Mark independently Allow lid prevents / reduces evaporation of water Ignore comments about the stirrer / surface area of copper tube	(3)

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	• less heat loss (to the atmosphere) **(1)** • (constant) supply of air into apparatus so less chance of incomplete combustion **(1)**	Allow 'no heat loss' Allow 'less energy lost' Allow oxygen / air prevents incomplete combustion' Allow oxygen / air allows complete combustion to occur Allow reverse argument if it is clear the copper can is being referred to	

(Total for Question 4 = 15 marks)

TOTAL FOR PAPER = 50 MARKS

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