Mark Scheme (Results)

October 2025

Pearson Edexcel International Advanced
Subsidiary Level in Chemistry
WCH13/01

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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.

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.

<table>
<tr><th>Question Number</th><th>Answer</th><th>Additional Guidance</th><th>Mark</th></tr>
<tr><td>1(a)</td><td>An answer that makes reference to the following points:

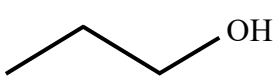
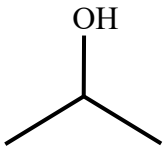
<table>
<tr><td>Test</td><td colspan="2">S</td><td colspan="2">T</td></tr>
<tr><td rowspan="2">Heating isomer with acidified potassium dichromate(VI)</td><td>Observation</td><td>Result</td><td>Observation</td><td>Result</td></tr>
<tr><td>orange to green (solution)</td><td>positive</td><td>the same as the observation in S</td><td>positive</td></tr>
<tr><td rowspan="2">Fehling’s test on product of heating isomer with acidified potassium dichromate(VI)</td><td>Observation</td><td>Result</td><td>Observation</td><td>Result</td></tr>
<tr><td>(changes to) orange / (brick) red / precipitate</td><td>positive</td><td>no visible change</td><td>negative</td></tr>
</table>
(1)

(1)</td><td>Allow orange to blue

Do not award precipitate

Allow solid / ppt / ppte for precipitate
Allow red brown
Ignore starting colour even if incorrect.
Do not award just brown</td><td>(2)</td></tr>
</table>

Question Number	Answer	Additional Guidance	Mark
1(b)	An answer that makes reference to the following point: • alcohol	Accept O-H (C-)OH, (C)-OH, hydroxy(l), Ignore primary and secondary Do not award OH^-, hydroxide, tertiary	**(1)** **Graduate**

Question Number	Answer	Additional Guidance	Mark
1(c)	An answer that makes reference to the following points: • Isomer S  **(1)** • Isomer T  **(1)**	Penalise non-skeletal formulae once only Ignore vertical connectivity Do not award incorrect horizontal connectivity	**(2)** **Graduate**

(Total for Question 1 = 5 marks)

Question Number	Answer	Additional Guidance	Mark
2(a)(i)	An answer that makes reference to the following points: • Ca^{2+} **(1)** • Ba^{2+} **(1)**	 Ignore Ca, Ca^{+}, calcium ions, Sr^{2+} Ignore Ba, Ba^{+}, barium ions	**(2)**

Question Number	Answer	Additional Guidance	Mark
2(a)(ii)	An answer that makes reference to the following points: • addition of sulfate ions ((aq)) / SO_4^{2-}((aq)) **(1)** • white **and** precipitate **(1)**	MP 2 depends on MP 1(or near miss) Allow incorrect formulae e.g. KSO_4 Accept addition of any (aqueous solution of) sulfate salt or sulfuric acid Ignore any additional other acids used Allow white **and** solid / crystals / ppte / ppt Possible TE from (a)(i) Ignore any incorrect name or formula of the precipitate	**(2)**

Question Number	Answer	Additional Guidance	Mark
2(b)(i)	An answer that makes reference to the following points: • I^- **(1)** • AgBr **(1)**	 Ignore iodide ions, I, iodine Ignore silver bromide Allow (**1**) for iodide ions and silver bromide	**(2)**

Question Number	Answer	Additional Guidance	Mark
2(b)(ii)	An answer that makes reference to the following points: • add dilute ammonia **and** the cream precipitate / bromide / solid is insoluble **(1)** • add concentrated ammonia **and** the cream precipitate / bromide / solid is soluble **(1)** Or • add **concentrated** sulfuric acid **(1)** • brown fumes observed **(1)**	Allow TE on incorrect silver halide in b(i) Depends on mention of just sulfuric acid Ignore other observations	**(2)**

(Total for Question 2 = 8 marks)

Question Number	Answer	Additional Guidance	Mark
3(a)(i)	An answer that makes reference to the following point: • ensure a uniform mixture / concentration	Allow to ensure thorough OWTTE mixing Ignore just mixing Ignore reference to dissolving	**(1)**

Question Number	Answer	Additional Guidance	Mark
3(a)(ii)	An answer that makes reference to the following point: • dilution does not affect the number of moles in the conical flask / in the titration	Allow additional water will not affect the final result / titre Allow does not add any extra sodium carbonate Do not award does not change the concentration	**(1)**

Question Number	Answer	Additional Guidance	Mark
3(a)(iii)	An answer that makes reference to the following point: • from yellow to orange	Do not award yellow / orange to red Ignore shades or tones e.g. dark or light	**(1)**

<table>
<tr><th>Question Number</th><th>Answer</th><th>Additional Guidance</th><th>Mark</th></tr>
<tr><td>3(b)(i)</td><td>• calculation of titre volumes
and
mean</td><td><u>Example of calculation</u>

<table><tr><th>Titration</th><th>Trial</th><th>1</th><th>2</th><th>3</th></tr><tr><td>Final volume / cm^3</td><td>24.45</td><td>48.50</td><td>24.95</td><td>29.05</td></tr><tr><td>Initial volume / cm^3</td><td>0.15</td><td>24.45</td><td>1.00</td><td>5.05</td></tr><tr><td>Titre / cm^3</td><td>24.30</td><td>24.05</td><td>23.95</td><td>24.00</td></tr></table>
((24.05 + 23.95 + 24.00) / 3) = 24.00

Allow just 24 for both titre 3 and the mean titre.</td><td>(1)</td></tr>
</table>

<table>
<tr><th>Question Number</th><th>Answer</th><th>Additional Guidance</th><th>Mark</th></tr>
<tr><td>3(b)(ii)</td><td>An answer that makes reference to the following point:

• fully correct balanced equation</td><td>

$Na_2CO_3 + 2HCl \rightarrow 2NaCl + H_2O + CO_2$

Ignore state symbols even if incorrect</td><td>(1)</td></tr>
</table>

Question Number	Answer		Additional Guidance	Mark
3(b)(iii)	• mol of HCl used in titre	**(1)**	Example of calculation $(24.00 \times 0.125) \div 1000 = 0.00300 / 3.00 \times 10^{-3}$ (mol)	**(5)**
	• mol of Na_2CO_3 in 250 cm^3	**(1)**	$(0.00300 \div 2) \times$ **10** $= 0.0150 / 1.50 \times 10^{-2}$ (mol)	
	EITHER		EITHER	
	• mass of Na_2CO_3	**(1)**	M_r $Na_2CO_3 = 106$ **and** $0.0150 \times 106 = 1.59$ (g)	
	• mol of water	**(1)**	mass of water $4.29 - 1.59 = 2.70$ **and** $2.70 \div 18 = 0.15$ (mol)	
	• value of n	**(1)**	mol ratio $Na_2CO_3 : H_2O$ 1:10, n = 10 note the final answer must be a whole number	
	OR		OR	
	• M_r of $Na_2CO_3 \cdot nH_2O$	**(1)**	$4.29 \div 1.50 \times 10^{-2} = 286$	
	• subtraction of M_r Na_2CO_3	**(1)**	$286 - 106 = 180$	
	• value of n	**(1)**	$n = 180 \div 18 = 10$ note the final answer must be a whole number	
			Allow TE throughout and from (b)(i)(ii)	
			Correct answer with no working scores 1	

(Total for Question 3 = 10 marks)

Question Number	Answer	Additional Guidance	Mark
4(a)	An answer that makes reference to the following points: • balancing **(1)** • state symbols **(1)**	MP 2 dependent on MP 1 or near miss e.g. KCO_3 $2KHCO_3(s) \rightarrow K_2CO_3(s) + H_2O(g) + CO_2(g)$ Ignore heat anywhere in the equation	**(2)**

Question Number	Answer	Additional Guidance	Mark
4(b)(i)	An answer that makes reference to the following point: • to retain the solid / mixture whilst allowing gas to escape	Ignore comments about gas pressure, explosion, heat	**(1)**

Question Number	Answer	Additional Guidance	Mark
4(b)(ii)	An answer that makes reference to the following point: • to ensure complete reaction / (thermal) decomposition	Allow all the hydrogen carbonate has decomposed Allow all the carbon dioxide **and** water have been removed Allow so that only potassium carbonate is left	**(1)**

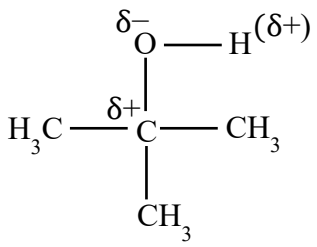
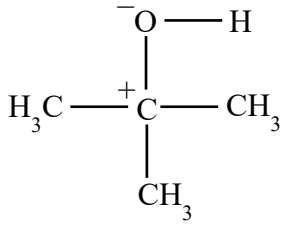
Question Number	Answer		Additional Guidance	Mark
4(b)(iii)			Example of calculation	**(6)**
	Allow TE from incorrect formulae and ratio 4(a) and incorrect ratio if ratio from 4(a) is not used.			
	Route 1			
	• M1 mass of water and carbon dioxide lost	**(1)**	12.00 – 8.90 = 3.10 (g)	
	• M2 mol of water and carbon dioxide lost	**(1)**	M_r water and carbon dioxide (18.0 + 44.0 = 62.0); 3.10 ÷ 62.0 = 0.0500 (mol)	
	EITHER		EITHER	
	• M3 mol $KHCO_3$ (using mole ratio from (4)(a))	**(1)**	0.0500 × 2 = 0.1 (mol)	
	• M4 mass $KHCO_3$ (using formula in (4)(a))	**(1)**	M_r $KHCO_3$ = 100.1; 0.1 × 100.1 = 10.0100 (g)	
	• M5 mass K_2CO_3 in the starting mixture	**(1)**	12.00 – 10.0100 = 1.99 (g)	
	• M6 % by mass K_2CO_3 in the mixture **and** 3SF	**(1)**	(1.99 ÷ 12.00) × 100 = 16.583 = 16.6% to 3SF	
	OR		OR	
	• M3 Total mol of K_2CO_3 at end	**(1)**	8.9 ÷ 138.2 = 0.0644 (mol)	
	• M4 mol K_2CO_3 at start	**(1)**	0.0644 – 0.05 = 0.0144 (mol)	
	• M5 mass K_2CO_3 at start	**(1)**	0.0144 × 138.2 = 1.99008 (g)	
	• M6 % by mass K_2CO_3 in the mixture **and** 3SF	**(1)**	(1.99008 ÷ 12.00) × 100 = 16.583 = 16.6% to 3SF	

	Route 2 mass K_2CO_3 in mixture before heating = k • M1 mol K_2CO_3 • M2 mol $KHCO_3$ (using mole ratio from (4)(a)) • M3 mass $KHCO_3$ • M4 rearrangement • M5 mass K2CO3 in the starting mixture • M6 % by mass K_2CO_3 in the mixture **and** 3SF	**(1)** **(1)** **(1)** **(1)** **(1)** **(1)**	 (8.9 – k) ÷ 138.2 ((8.9 – k) ÷ 138.2) × 2 = (8.9 – k) ÷ 69.1 12 – k = ((8.9 – k) ÷ 69.1) × 100.1 1.44863k – k = 12.89281 – 12 k = 1.9981 (1.9981 ÷ 12) x 100 = 16.651% 16.7% 3sf	

Question Number	Answer	Additional Guidance	Mark
4(b)(iv)	An answer that makes reference to the following point: • the percentage uncertainties in weighing will be larger	Allow the answer will be less accurate / less precise Allow the answer will be more uncertain Allow greater percentage error	**(1)**

(Total for Question 4 = 11 marks)

Question Number	Answer	Additional Guidance	Mark
5(a)(i)	An answer that makes reference to the following point: • nucleophilic substitution	Allow nucleophile or phonetic spelling e. g nucleophillic Ignore SN1 or SN2 Do not award electrophilic, reduction, addition, elimination	**(1)**

Question Number	Answer	Additional Guidance	Mark
5(a)(ii)	An answer that makes reference to the following point: • 	Ignore dipole on the H of the OH group Ignore curly arrows, lone pairs and dipole arrows Ignore other molecules Do not award 	**(1)**

Question Number	Answer	Additional Guidance	Mark
5(b)(i)	An answer that makes reference to the following point: • vapour from **concentrated hydrochloric acid** / **HCl** (gas) is toxic	Allow **concentrated hydrochloric acid** / **HCl** (gas) is corrosive / an irritant / toxic Ignore any comments about chlorine gas Ignore just harmful / harmful to lungs	**(1)**

Question Number	Answer	Additional Guidance	Mark
5(b)(ii)	An explanation that makes reference to the following points: • the reaction is exothermic or the reaction forms gases **(1)** • release the pressure **(1)**	 Allow HCl Allow release the gases / vapours	**(2)**

Question Number	Answer	Additional Guidance	Mark
5(b)(iii)	An answer that makes reference to the following point: • layer Y (the lower layer) (is the aqueous layer) **and** density of water is 1 g cm^{-3} and 2-chloro-2-methylpropane has a density of 0.87 g cm^{-3}	Data is on the first page of the clip Allow layer Y has the greater density	**(1)**

Question Number	Answer	Additional Guidance	Mark
5(b)(iv)	An answer that makes reference to the following point: • to neutralise (excess / unreacted) (hydrochloric) acid	Allow remove / react	**(1)**

Question Number	Answer	Additional Guidance	Mark
5(b)(v)	An answer that makes reference to the following point: • (sodium sulfate is a) drying agent	Allow to remove / absorb water Ignore to make the solution clear Do not award dehydration	**(1)**

Question Number	Answer	Additional Guidance	Mark
5(b)(vi)	An answer that makes reference to the following points: Scoring points • position of the thermometer bulb (is too high) • so inaccurate measurement of the temperature (of the vapour) • water in and out of the condenser is the wrong way round (water should be in at the bottom and out at the top) • less efficient cooling / condensing of the vapour • no outlet • pressure builds-up 6 scoring points scores 3 4 or 5 scoring points scores 2 2 or 3 scoring points score 1 1 scoring point scores 0	Do not award if their suggested position is incorrect Allow air bubbles would form / condenser jacket is not full of water Do not award condensation does not occur Allow explosion could occur	**(3)**

Question Number	Answer	Additional Guidance	Mark
5(c)	A description that makes reference to the following points: Either • infra-red spectrum of 2-methylpropan-2-ol has a peak at 3350 cm^{-1} (which is not present in the chloro compound) **(1)** • as the reaction progresses, this peak decreases **(1)** Or • infra-red spectrum of 2-chloro-2-methylpropane has a peak at 590 cm^{-1} (which is not present in the alcohol compound) **(1)** • as the reaction progresses, this peak increases **(1)**	Allow wave number between 3750 − 3200 cm^{-1} Allow peak disappears Allow wave number between 550 − 700 cm^{-1} Allow peak appears Ignore any other differences described	**(2)**

Question Number	Answer	Additional Guidance	Mark
5(d)	• mass 2-methylpropan-2-ol **and** mol 2-methylpropan-2-ol **(1)** **either** • mass 2-chloro-2-methylpropane **(1)** • percentage yield **(1)** **or** • mol 2-chloro-2-methylpropane **(1)** • percentage yield **(1)**	<u>Example of calculation</u> 10.0 × 0.78 = 7.80 (g) M_r 2-methylpropan-2-ol = 74.0 7.80 ÷ 74.0 = 0.10541 (mol) (0.10541 mol 2-chloro-2-methyl propane) M_r 2-chloro-2-methyl propane 92.5; 0.10541 × 92.5 = 9.75043(g) (5.60 ÷ 9.75043) × 100 = 57.4% / 57% range 57 to 58% 5.6 ÷ 92.5 = 0.060541 (mol) (0.060541 ÷ 0.10541) × 100 = 57.4% / 57% range 57 to 58% Ignore SF except 1 SF Allow TE throughout Correct answer with no working scores 3	**(3)**

(Total for Question 5 = 16 marks)

TOTAL FOR PAPER = 50 MARKS