



# Mark Scheme (Results)

Summer 2024

Pearson Edexcel International Advanced Level  
in Chemistry (WCH16)  
Paper 01 Practical Skills in Chemistry II

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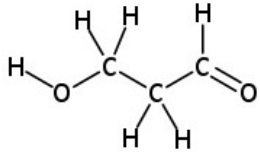
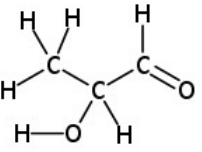
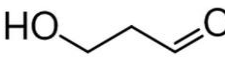
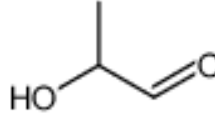
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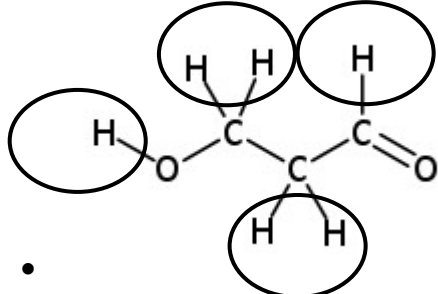
## General Marking Guidance

- 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	Answer	Additional Guidance	Mark
1(a)	<p>An answer that makes reference to the following points:</p> <ul style="list-style-type: none"> <li>-OH <b>and</b> because misty fumes/HCl (with PCl<sub>5</sub>)</li> <li>not a carboxylic acid (as it does not react with sodium hydrogencarbonate/ NaHCO<sub>3</sub>)</li> </ul>	<p>(1) Allow OH because positive result (in test 1) Allow hydroxy(l) Allow alcohol or carboxylic acid present Allow COOH/ for carboxylic acid Allow just alcohol Do not award OH<sup>-</sup></p> <p>(1) Allow not an acid Allow not carboxylic Allow this is the test for a carboxylic acid and it is negative/no visible reaction Ignore carboxy(l)</p>	(2)

Question Number	Answer	Additional Guidance	Mark
1(b)	<p>An answer that makes reference to the following point:</p> <ul style="list-style-type: none"> <li>aldehyde/CHO/C=O  <math display="block">\begin{array}{c}   \\ \text{H} \end{array}</math> </li> </ul>	<p>Ignore carbonyl/ C=O Do not award COH</p> <p>If both a name and structure are given both must be correct.</p>	(1)

Question Number	Answer	Additional Guidance	Mark
1(c)(i)	<p>An answer that makes reference to the following points:</p> <ul style="list-style-type: none"> <li data-bbox="360 256 1189 408">•  (1)</li> <li data-bbox="360 448 1189 600">•  (1)</li> </ul>	    Allow skeletal / structural formulae or a combination Ignore connectivity of OH unless horizontal	(2)

Question Number	Answer	Additional Guidance	Mark
1(c)(ii)	<p>An answer that makes reference to the following point:</p> <ul style="list-style-type: none"> <li data-bbox="439 895 875 1190">• </li> </ul>	Allow skeletal / structural formula Annotations may be shown in ci  Allow numbers/ letters instead of circles Allow other atoms to be included with the Hs if circled. Ignore names even if incorrect	(1)

(Total for Question 1 = 6 marks)

Question Number	Answer	Additional Guidance	Mark				
2(a)(i)	<p>An answer that makes reference to the following points:</p> <ul style="list-style-type: none"> <li> <table border="1" data-bbox="524 293 913 544"> <tr> <td data-bbox="524 293 913 437">Observation on adding a few drops of sodium hydroxide</td> </tr> <tr> <td data-bbox="524 437 913 544">(grey)green precipitate</td> </tr> </table> </li> <li> <table border="1" data-bbox="524 580 913 831"> <tr> <td data-bbox="524 580 913 692">Observation on adding an excess of sodium hydroxide</td> </tr> <tr> <td data-bbox="524 692 913 831">(dark/ deep) green solution/sol/soln</td> </tr> </table> </li> </ul>	Observation on adding a few drops of sodium hydroxide	(grey)green precipitate	Observation on adding an excess of sodium hydroxide	(dark/ deep) green solution/sol/soln	<p>(1)</p> <p>Allow ppt / ppte /solid Ignore any reference to shade of green e.g. pale Do not award just grey</p> <p>(1)</p> <p>Allow green (aq) Ignore green ppt dissolves Do not award pale green If answers are reversed score 1</p> <p>No TE on wrong colour ppt.</p>	(2)
Observation on adding a few drops of sodium hydroxide							
(grey)green precipitate							
Observation on adding an excess of sodium hydroxide							
(dark/ deep) green solution/sol/soln							

Question Number	Answer	Additional Guidance	Mark
2(a)(ii)	<p>An answer that makes reference to the following point:</p> <ul style="list-style-type: none"> <li>(chromium(III) hydroxide is) amphoteric</li> </ul>	<p>Allow it reacts with (an acid and) a base Allow it can behave as an acid (and a base)</p> <p>Ignore anything about ligands, solubility, complex ions, variable oxidation states, deprotonation, transition metal</p>	(1)

Question Number	Answer	Additional Guidance	Mark
2(b)	<p>An answer that makes reference to the following points:</p> <ul style="list-style-type: none"> <li>Hydrogen peroxide is an oxidising agent</li> <li>Cr (oxidation number changes from) +3 to +6</li> </ul>	<p>(1) Allow oxidant Allow it is an oxidising agent Allow oxidising agent Allow it oxidises the Cr Ignore it is a catalyst Do not award if there is a contradiction i.e. it is an oxidising agent and reduces the Cr</p> <p>(1) Allow III/VI 3<sup>+</sup>/6<sup>+</sup></p>	(2)

Question Number	Answer	Additional Guidance	Mark
2(c)	<p>An answer that makes reference to the following point:</p> <ul style="list-style-type: none"> <li><math>2\text{CrO}_4^{2-} + 2\text{H}^+ \rightleftharpoons \text{Cr}_2\text{O}_7^{2-} + \text{H}_2\text{O}</math></li> </ul>	<p>Allow multiples Allow <sup>-2</sup> Ignore state symbols even if incorrect Do not award if electrons included</p>	(1)

(Total for Question 2 = 6 marks)

Question Number	Answer	Additional Guidance	Mark
3(a)(i)	<p>An answer that makes reference to the following points:</p> <ul style="list-style-type: none"> <li>• KI/I/iodide reacts with the <math>\text{MnO}_4^-</math> /manganate ((VII)) (rapidly)</li> <li>• <math>\text{MnO}_4^-</math> /manganate ((VII)) is <b>all</b> used up (so the reaction will stop)</li> </ul>	<p>(1) Allow the <math>\text{MnO}_4^-</math> gets reduced Allow the I/iodide gets oxidised by the <math>\text{MnO}_4^-</math> If oxidation numbers given, they must be correct Do not award the KI/I/iodide reacts with ethanedioate ions</p> <p>(1) Allow so the <math>\text{MnO}_4^-</math> /manganate ((VII)) can no longer react (with the ethanedioate ions) Allow the manganate ((VII)) is the limiting reagent (with the KI) (so the reaction stops)</p> <p>KI/I/iodide reacts with <b>all</b> the <math>\text{MnO}_4^-</math> /manganate ((VII)) score 2</p> <p>Ignore any reference to quenching</p>	(2)

Question Number	Answer	Additional Guidance	Mark
3(a)(ii)	<p>An answer that makes reference to the following point:</p> <ul style="list-style-type: none"> <li>• when the solution turns pale yellow/ straw coloured</li> </ul>	<p>Ignore towards the end of the titration Allow just yellow Allow yellow-brown Allow straw brown Do not award just brown/ pale brown/orange brown Do not award any reference to a ppt forming</p>	(1)



Question Number	Answer	Additional Guidance	Mark																		
3(b)(i)	<ul style="list-style-type: none"> <li data-bbox="360 225 853 252">• suitable axes and labels with units</li>   <li data-bbox="405 296 965 475">Allow V/v/vol for volume <b>and</b> cm<sup>3</sup> Na<sub>2</sub>S<sub>2</sub>O<sub>3</sub> does not need to be seen Allow T/t for time <b>and</b> min The points plotted must cover at least half the grid in both directions (1)</li>   <li data-bbox="360 595 965 663">• points plotted correctly within one small square (1)</li>   <li data-bbox="360 743 965 770">• curved line of best fit (1)</li>   <li data-bbox="309 858 831 922">If graph is reversed penalise M1 only so max 2</li> </ul>	<p data-bbox="999 220 1234 252">Example of graph</p> <div data-bbox="1189 384 1827 999" style="text-align: center;"> <table border="1" data-bbox="1301 416 1827 935"> <caption>Data points estimated from the graph</caption> <thead> <tr> <th>Time / min</th> <th>Volume Na<sub>2</sub>S<sub>2</sub>O<sub>3</sub> / cm<sup>3</sup></th> </tr> </thead> <tbody> <tr><td>0</td><td>2.0</td></tr> <tr><td>1</td><td>1.9</td></tr> <tr><td>2</td><td>1.8</td></tr> <tr><td>3</td><td>1.6</td></tr> <tr><td>4</td><td>1.0</td></tr> <tr><td>5</td><td>0.5</td></tr> <tr><td>6</td><td>0.2</td></tr> <tr><td>7</td><td>0.1</td></tr> </tbody> </table> </div>	Time / min	Volume Na <sub>2</sub> S <sub>2</sub> O <sub>3</sub> / cm <sup>3</sup>	0	2.0	1	1.9	2	1.8	3	1.6	4	1.0	5	0.5	6	0.2	7	0.1	(3)
Time / min	Volume Na <sub>2</sub> S <sub>2</sub> O <sub>3</sub> / cm <sup>3</sup>																				
0	2.0																				
1	1.9																				
2	1.8																				
3	1.6																				
4	1.0																				
5	0.5																				
6	0.2																				
7	0.1																				

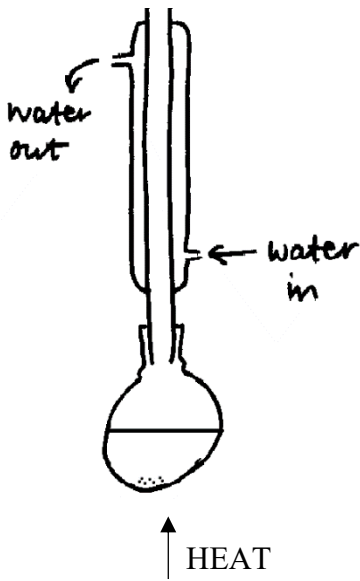
Question Number	Answer	Additional Guidance	Mark
3(b)(ii)	An answer that makes reference to the following point: <ul style="list-style-type: none"> <li>slow at the start, speeds up and then slows down</li> </ul>	Allow just slow, fast, slow Allow low for slow Ignore any comment about the gradient and time	(1)

Question Number	Answer	Additional Guidance	Mark
3(b)(iii)	An answer that makes reference to the following points: <ul style="list-style-type: none"> <li><math>\text{Mn}^{2+}</math> is a catalyst (1)</li> <li>formed during the reaction (so the rate increases) (1)</li> <li>reaction slows down as the reactants/ manganate ions/ethanedioate ions get used up (1)</li> </ul>	product is a catalyst / autocatalytic  Do not award the reaction slows down as the catalyst/ thiosulfate/iodide gets used up.	(3)

(Total for Question 3 = 10 marks)

Question Number	Answer	Additional Guidance	Mark
4(a)	<ul style="list-style-type: none"> <li>moles of salicylic acid</li> <li>mass of methanol</li> <li>moles of methanol</li> </ul> <p><b>and</b> 2.4719 (mol) &gt; 0.14493 (mol) / 2.32697 mol in excess</p> <p>Alternative solution using masses instead of moles for M3 0.14493 (mol) × 32 = 4.64 (g) of methanol <b>and</b> 79.1(g) &gt; 4.64(g) / the methanol is 74.46 g in excess</p>	<p><u>Example of calculation:</u> Ignore early and incorrect rounding or truncating</p> <p>(1) 20.0/138.0 = 0.14493 (mol)</p> <p>(1) 100 x 0.791 = 79.1 (g)</p> <p>(1) 79.1/32.0 = 2.4719 (mol)</p> <p>Allow just methanol is in excess if both mol have been calculated</p> <p>Ignore SF except 1 SF</p> <p>TE for wrong moles in M3 as long as methanol moles are greater than salicylic acid moles</p> <p>A ratio of 17:1 will score 3 marks</p>	(3)

Question Number	Answer	Additional Guidance	Mark
4(b)	<p>An answer that makes reference to the following point:</p> <ul style="list-style-type: none"> <li>acts as a catalyst</li> </ul>	<p>Allow it catalyses the reaction Ignore just speeds up the reaction Ignore supplies hydrogen ions/acidifies the reaction Ignore dehydrates Ignore any reference as to how it acts as a catalyst even if wrong.</p>	(1)

Question Number	Answer	Additional Guidance	Mark
4(c)	<ul style="list-style-type: none"> <li>• round-bottomed / pear-shaped flask containing mixture and heat</li> <li>• vertical condenser with water jacket and water flowing in the correct direction</li> <li>• no gaps and open condenser and apparatus would work</li> </ul>	<p>Example of diagram</p>  <p>(1) Allow any indication of heat including an arrow or water bath or electrical heater or Bunsen burner Ignore missing anti-bumping granules Do not award conical flask or flask with no liquid</p> <p>(1) Ignore thermometer</p> <p>(1) Do not award if the condenser and flask are one piece of apparatus <b>unless both are labelled</b></p> <p>Allow just M1 for distillation apparatus</p>	(3)

Question Number	Answer	Additional Guidance	Mark
4(d)	<p>An answer that makes reference to the following points:</p> <ul style="list-style-type: none"> <li>• add sodium carbonate (solution) to the separating funnel (stopper it) <b>and</b> invert/shake/ swirl/agitate/mix</li> <li>• open the stopcock/tap to release the pressure/gas/ carbon dioxide</li> </ul>	<p>(1) Allow add sodium carbonate (solution) to the funnel <b>and</b> invert/shake/ swirl/agitate/mix Allow add <b>it</b> to the separating funnel <b>and</b> invert/shake/ swirl/ agitate/mix Ignore any reference to layers</p> <p>(1) Allow remove the stopper to release the pressure/gas/carbon dioxide Allow opening the funnel to release the pressure/gas/carbon dioxide</p> <p>Ignore subsequent steps</p>	(2)

Question Number	Answer	Additional Guidance	Mark
4(e)	<ul style="list-style-type: none"> <li>• moles of salicylic acid (no mark as already awarded in (a))</li> <li>• <math>M_r</math> methyl salicylate</li> <li>• maximum mass of methyl salicylate</li> <li>• percentage yield calculation <b>and</b> answer to 2 or 3 SF</li> </ul> <p>Common wrong answers</p> <p>Using a <math>M_r</math> of 153 gives an answer of 63.587% and will score 2 if 2-3 SF</p> <p>Using a <math>M_r</math> of 140 gives an answer of 69.492% and will score 2 if 2-3 SF</p>	<p><u>Example of calculation:</u></p> <p>Ignore intermediate rounding and truncating</p> <p><math>20.0/138.0 = 0.14493</math> (mol)</p> <p>(1) <math>152</math> (g mol<sup>-1</sup>)</p> <p>(1) <math>152 \times 0.14493 = 22.029</math> (g)</p> <p><math>14.1 \div 22.029 \times 100 = 64.007</math></p> <p>(1) <math>64</math> (%)/<math>64.0</math> (%)</p> <p>Correct answer with some working scores 3</p> <p>TE on wrong molar mass for M2 but only allow M3 if percentage is less than 100%.</p> <p>If no attempt has been made at calculating the <math>M_r</math> of methyl salicylate score 0.</p>	(3)

(Total for Question 4 = 12 marks)

Question Number	Answer	Additional Guidance	Mark
5(a)(i)	<p>An answer that makes reference to the following points:</p> <ul style="list-style-type: none"> <li>(hold damp) red litmus paper (over the mouth of the flask and it) will turn blue</li> <li>repeat until the litmus paper remains red/no colour change</li> </ul> <p>Allow testing with <b>concentrated</b> HCl producing white smoke/solid for M1 and no longer producing white smoke for M2</p>	<p>(1) Allow UI/full range paper and a change to blue/purple Allow just litmus turns blue</p> <p>(1) Allow until the test is negative Allow damp red litmus no longer turns blue OWTTE score 2 Ignore until it no longer smells</p> <p>Do not award placing the litmus into the conical flask. Score 0.</p>	(2)

Question Number	Answer	Additional Guidance	Mark
5(a)(ii)	<p>An answer that makes reference to the following point:</p> <ul style="list-style-type: none"> <li>corrosive <b>and</b> toxic</li> </ul>	Allow poisonous for toxic	(1)

Question Number	Answer	Additional Guidance	Mark
5(a)(iii)	<p>An answer that makes reference to one of the following points:</p> <ul style="list-style-type: none"> <li>carry out in a fume cupboard or wear gloves (when testing the vapours)</li> </ul>	<p>Allow carry out in a well-ventilated laboratory Ignore wearing a gas mask Ignore use tongs etc</p>	(1)

Question Number	Answer	Additional Guidance	Mark
5(b)(i)	<ul style="list-style-type: none"> <li>moles of NaOH at the start (1)</li> <li>moles of HCl equals moles of NaOH at the end (1)</li> <li>moles of NaOH used up/moles of NH<sub>4</sub>X (1)</li> <li>molar mass of NH<sub>4</sub>X (1)</li> </ul>	<p><u>Example of calculation</u></p> <p><math>50.0 \times 1.00 \div 1000 = 0.05 \text{ (mol)}</math></p> <p><math>26.80 \times 1.00 \div 1000 = 0.0268 \text{ (mol)}</math></p> <p><math>0.05 - 0.0268 = 0.0232 \text{ (mol)}</math></p> <p><math>2.27 \div 0.0232 = 97.845 \text{ (g mol}^{-1}\text{)}</math></p> <p>Correct answer with or without working scores 4 TE throughout Ignore SF except 1 SF</p>	(4)



Question Number	Answer	Additional Guidance	Mark
5(b)(ii)	<ul style="list-style-type: none"> <li>mass of <math>\text{NH}_4</math> and deduction from 97.845 (<math>\text{g mol}^{-1}</math>) (1)</li> <li>selection of Br / <math>\text{Br}^-</math> / bromide/ bromine (79.9) (as the <math>M_r</math> is closest) (1)</li> </ul>	<p><u>Example of calculation:</u></p> <p><math>14.0 + 4.0 = 18.0</math>  and <math>97.8 - 18.0 = 79.8</math>  The subtraction calculation does not have to be seen as long as the correct number is noted i.e. 18 deducted.</p> <p>TE on closest halide as long as 18 has been subtraction  Note this answer may be in bi  Do not award <math>\text{Br}_2</math></p>	(2)

Question Number	Answer	Additional Guidance	Mark
5(b)(iii)	<p>An answer that makes reference to the following points:</p> <ul style="list-style-type: none"> <li>(to a solution of <math>\text{NH}_4\text{X}</math> add) silver nitrate (solution) <b>and</b> (dilute) nitric acid (1)</li> <li>cream ppt/solid (1)</li> </ul>	<p>Allow TE on the halide from bii</p> <p>Ignore just acidified</p> <p>Allow off-white / pale yellow  Ignore any reference to adding ammonia solution to the ppt  M2 is dependent on M1 or a near miss such as a wrong acid or no acid.</p>	(2)

Question Number	Answer	Additional Guidance	Mark
5(c)	<p>An answer that makes reference to the following points:</p> <p>Advantage</p> <ul style="list-style-type: none"> <li>• you can do more titrations/ 4 titrations</li> </ul> <p>OR you can do a range finder titration</p> <p>OR you can calculate a mean titre (1)</p> <ul style="list-style-type: none"> <li>• any anomalies or range finder titration can be discarded</li> </ul> <p>OR you can get concordant results (1)</p> <p>Disadvantage</p> <ul style="list-style-type: none"> <li>• titre will be smaller / smaller volume of acid required (1)</li> <li>• will have a greater (%) uncertainty/ percentage error (1)</li> </ul>	<p>Ignore any references to accuracy/ reliability for both the advantages and disadvantages</p> <p>Allow just smaller volume</p> <p>Ignore any reference to an inaccurate molar mass</p>	(4)

(Total for Question 5 = 16 marks)

(Total for Paper = 50 marks)

