GCE
Chemistry A

Unit H432/03: Unified chemistry

Advanced GCE

Mark Scheme for June 2018
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This mark scheme is published as an aid to teachers and students, to indicate the requirements of the examination. It shows the basis on which marks were awarded by examiners. It does not indicate the details of the discussions which took place at an examiners’ meeting before marking commenced.

All examiners are instructed that alternative correct answers and unexpected approaches in candidates’ scripts must be given marks that fairly reflect the relevant knowledge and skills demonstrated.

Mark schemes should be read in conjunction with the published question papers and the report on the examination.

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Annotations available in RM Assessor

<table>
<thead>
<tr>
<th>Annotation</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>✅</td>
<td>Correct response</td>
</tr>
<tr>
<td>✗</td>
<td>Incorrect response</td>
</tr>
<tr>
<td>▲</td>
<td>Omission mark</td>
</tr>
<tr>
<td>BOD</td>
<td>Benefit of doubt given</td>
</tr>
<tr>
<td>CON</td>
<td>Contradiction</td>
</tr>
<tr>
<td>RE</td>
<td>Rounding error</td>
</tr>
<tr>
<td>SF</td>
<td>Error in number of significant figures</td>
</tr>
<tr>
<td>ECF</td>
<td>Error carried forward</td>
</tr>
<tr>
<td>11</td>
<td>Level 1</td>
</tr>
<tr>
<td>12</td>
<td>Level 2</td>
</tr>
<tr>
<td>13</td>
<td>Level 3</td>
</tr>
<tr>
<td>NBOD</td>
<td>Benefit of doubt not given</td>
</tr>
<tr>
<td>SEEN</td>
<td>Noted but no credit given</td>
</tr>
<tr>
<td>I</td>
<td>Ignore</td>
</tr>
<tr>
<td>BP</td>
<td>Blank page</td>
</tr>
</tbody>
</table>
Abbreviations, annotations and conventions used in the detailed Mark Scheme (to include abbreviations and subject-specific conventions).

<table>
<thead>
<tr>
<th>Annotation</th>
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</tr>
</thead>
<tbody>
<tr>
<td>DO NOT ALLOW</td>
<td>Answers which are not worthy of credit</td>
</tr>
<tr>
<td>IGNORE</td>
<td>Statements which are irrelevant</td>
</tr>
<tr>
<td>ALLOW</td>
<td>Answers that can be accepted</td>
</tr>
<tr>
<td>( )</td>
<td>Words which are not essential to gain credit</td>
</tr>
<tr>
<td>BOLD</td>
<td>Emboldened words must be present in answer to score a mark</td>
</tr>
<tr>
<td>ECF</td>
<td>Error carried forward</td>
</tr>
<tr>
<td>AW</td>
<td>Alternative wording</td>
</tr>
<tr>
<td>ORA</td>
<td>Or reverse argument</td>
</tr>
</tbody>
</table>
Subject-specific Marking Instructions

INTRODUCTION

Your first task as an Examiner is to become thoroughly familiar with the material on which the examination depends. This material includes:

- the specification, especially the assessment objectives
- the question paper
- the mark scheme.

You should ensure that you have copies of these materials.

You should ensure also that you are familiar with the administrative procedures related to the marking process. These are set out in the OCR booklet Instructions for Examiners. If you are examining for the first time, please read carefully Appendix 5 Introduction to Script Marking: Notes for New Examiners.

Please ask for help or guidance whenever you need it. Your first point of contact is your Team Leader.
<table>
<thead>
<tr>
<th>Question</th>
<th>Answer</th>
<th>Marks</th>
<th>Guidance</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 (a) (i)</td>
<td>Hydrogen/H ✓</td>
<td>1</td>
<td>ALLOW H₂</td>
</tr>
<tr>
<td>1 (a) (ii)</td>
<td>Helium/He ✓</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>1 (a) (iii)</td>
<td>Magnesium/Mg ✓</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>1 (a) (iv)</td>
<td>Sulfur/S ✓</td>
<td>1</td>
<td>ALLOW sulphur; S₈</td>
</tr>
<tr>
<td>1 (a) (v)</td>
<td>Chlorine/C OR fluorine/F ✓</td>
<td>1</td>
<td>ALLOW Cl₂ OR F₂</td>
</tr>
<tr>
<td>1 (a) (vi)</td>
<td>Phosphorus/P ✓</td>
<td>1</td>
<td>ALLOW P₄</td>
</tr>
<tr>
<td>1 (a) (vii)</td>
<td>Carbon/C ✓</td>
<td>1</td>
<td>ALLOW silicon/Si</td>
</tr>
<tr>
<td>1 (a) (viii)</td>
<td>Oxygen/O ✓</td>
<td>1</td>
<td>ALLOW O₂</td>
</tr>
<tr>
<td>Question</td>
<td>Answer</td>
<td>Marks</td>
<td>Guidance</td>
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</tbody>
</table>
| (b) | **NaCl/ OR MgCl₂**  
Giant ionic OR ionic lattice ✓  
**Ions are mobile in liquid state ✓**  | 2 marks | 5  
**IGNORE aqueous/dissolved ions are mobile**  
**IGNORE ‘free ions’ AND ‘ions are free to carry current’**  
**ALLOW ‘are molecules’**  
**IGNORE**  
• permanent dipole(–dipole) forces  
• IDID and LDF  
• van der Waals  
**ALLOW attraction between ions for ionic bonds**  
**ALLOW intermolecular forces for London forces**  
**ALLOW overcome for break**  
**ALLOW indirect comparison, i.e.**  
• Ionic bonds are strong AND London forces are weak  
**OR**  
• Ionic bonds need a large amount of energy to break AND London forces need little energy to break | |
| **SiCl₄ OR PCl₃ OR SC₃**  
(Simple) molecular OR simple covalent (lattice) ✓  
Induced dipole(–dipole) forces/interactions  
OR London forces ✓ | 2 marks |  
**ALLOW**  
comparison of bond strengths  
1 mark  
• Ionic bonds are stronger than London forces  
**OR**  
• Ionic bonds need more energy to break than London forces ✓ | |
<p>| <strong>Comparison of bond strengths</strong> | 1 mark | | |
| <strong>Total</strong> | 13 | | |</p>
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</table>
| 2 (a)    | **Graph**<br>Graph of volume (y axis) against time (x axis)<br>**AND** Axes labelled with correct units<br>**AND** At least half graph paper in both directions<br>**AND** Linear scales ✓<br><strong>Points</strong><br>7 points from 200–1400 s plotted ✓<br>Point at 0,0 not required<br><strong>Line</strong><br>Curve drawn through origin (0,0) ✓<br>**AND**<br>Curve not drawn with straight lines between points.<br><strong>Rate</strong><br>Attempted tangent on graph drawn to curve at<br>
\[ t = 500 \pm 100 \text{ s} \ ✓ \]

Rate calculated in range 0.037–0.047 (cm³ s⁻¹) ✓<br>e.g. for graph in guidance: \[ \frac{50 - 11}{920 - 0} = 0.042 \]

---------------------------------------

For tangents not drawn at 500 ± 100 s,<br>• ALLOW ECF ONLY for a tangent drawn to the candidate’s line.<br>• Then calculate the gradient from candidate’s tangent.

For inverse graphs of time against volume,<br>• Graph mark will not be scored.<br>• All other marks are available.<br>• **BUT** rate = 1/ gradient = 0.037–0.047 (cm³ s⁻¹)

ALLOW V OR Vol for volume<br>ALLOW t for time<br>For ‘s’, ALLOW sec, seconds, etc

**CARE:**<br>Use of x and y coordinates at \( t = 500 \text{ s} \) scores zero,<br>e.g. For volume = 33 cm³ and time = 500 s,<br>\[ x \text{ and } y \text{ coordinates gives } \frac{33}{500} = 0.066 \]
<table>
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<tr>
<td>(ii)</td>
<td><strong>FIRST CHECK THE ANSWER ON ANSWER LINE</strong>&lt;br&gt;<strong>If answer = 0.092 (mol dm(^{-3})) award 3 marks</strong>&lt;br&gt;---</td>
<td>3</td>
<td>ALLOW ECF throughout&lt;br&gt;ALLOW 2 SF up to calculator value of 2.291666667 (\times 10^{-3})&lt;br&gt;ALLOW calculation using ideal gas equation provided that (p = \sim 10^5) Pa and (T) in range 293–298 K.&lt;br&gt;ALLOW use of 8.31 for (R) (gives same answer)&lt;br&gt;e.g. (n(O_2) = \frac{1 \times 10^5 \times 55 \times 10^{-6}}{8.314 \times 298} = 2.22 \times 10^{-3}) (mol) ✓&lt;br&gt;(n(H_2O_2) = 2.22 \times 10^{-3} \times 2 = 4.44 \times 10^{-3}) (mol) ✓&lt;br&gt;([H_2O_2] = \frac{4.44 \times 10^{-3} \times 1000}{50.0} = 0.089) (mol dm(^{-3})) ✓&lt;br&gt;(2 SF)&lt;br&gt;<strong>NOTE:</strong> 293 K gives 0.090 (mol dm(^{-3}))</td>
</tr>
<tr>
<td>(b)</td>
<td>(2\text{MnO}_4^- + 5\text{H}_2\text{O}_2 + 6\text{H}^+ \rightarrow 2\text{Mn}^{2+} + 8\text{H}_2\text{O} + 5\text{O}_2)</td>
<td>2</td>
<td>ALLOW multiples&lt;br&gt;ALLOW ⇌ instead of (\rightarrow) sign&lt;br&gt;ALLOW 1 mark for final equation with correct balancing numbers AND ONE small slip in a formula OR charge&lt;br&gt;IGNORE annotations around equations, i.e. treat as rough working&lt;br&gt;ALLOW 1 mark for: (2\text{H}_2\text{O}_2 \rightarrow 2\text{H}_2\text{O} + \text{O}_2) (<strong>(\text{H}_2\text{O}_2) is acting as both reducing and oxidising agent)</strong>&lt;br&gt;Correctly balanced equation for (\text{MnO}_4^-/\text{H}_2\text{O}_2) reaction but no cancelling of (\text{H}^+) and/or (e^-) ✓&lt;br&gt;Overall equation correct with all species cancelled ✓</td>
</tr>
</tbody>
</table>
### Question 2c

#### (i) Equation

- **Equation**
  
  \[
  \text{[Co(H}_2\text{O)}_6]^{2+} + 4\text{Cl}^{-} \rightleftharpoons [\text{CoCl}_4]^{2-} + 6\text{H}_2\text{O}
  \]
  
  \[\text{OR} \quad \text{[Co(H}_2\text{O)}_6]^{2+} + 4\text{HCl} \rightleftharpoons [\text{CoCl}_4]^{2-} + 6\text{H}_2\text{O} + 4\text{H}^+ \checkmark \]

  **Guidance**
  
  ALLOW reverse equation:
  
  \[\text{[CoCl}_4]^{2-} + 6\text{H}_2\text{O} \rightleftharpoons [\text{Co(H}_2\text{O)}_6]^{2+} + 4\text{Cl}^{-}\]
  
  but take care for subsequent explanations

  IGNORE state symbols (even if wrong)

  For \([\text{CoCl}_4]^{2-}\), ALLOW \(\text{CoCl}_4^{2-}\), \((\text{CoCl}_4)^{2-}\)
  
  For other representations, contact TL

  **Marks** 1

#### (ii) Equilibrium shift

- **Equilibrium shift**
  
  - equilibrium (shifts) **to right** at high **temperature**/100°C
  
  OR equilibrium shifts to left at low temperature/0°C √

  **CARE:** Direction of shift depends on direction of equilibrium equation from 2c(i). Either look back or see the equation copied at bottom of 2c(ii) marking zone.

  **Guidance**
  
  Mark independently

  ALLOW suitable alternatives for ‘to right’ e.g. towards products OR in forward direction OR ‘favours the right’ ORA for ‘to left’

  Temperature required but

  ALLOW ‘in ice for low temperature

  OR ‘in boiling/hot water’ for high temperature

  IGNORE shift to blue side or pink side

  **Marks** 2

### Total

**13**
<table>
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</tr>
</thead>
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| 3 (a)    | Overall 3– charge shown (outside brackets) for at least **ONE** isomer ✓  
3– must apply to the overall charge of structures  
1 mark for each isomer ✓ ✓  
- *Bonds must go to O ligand atoms on EACH structure*  
- **ALLOW** unambiguous structures; ethanedioate ions can include C atoms  
For other structures that might be creditworthy, contact TL | 3     | **ALLOW** –3 for 3–  
**IGNORE** charges or dipoles on atoms within diagrams (even if wrong)  
Square brackets **NOT** required  
-------------------------------------------------------  
**3D**  
Must contain 2 ‘out wedges’, 2 ‘in wedges’ and 2 lines in plane of paper OR 4 lines, 1 ‘out wedge’ and 1 ‘in wedge’:  
For bond into paper, **ALLOW**:  
**ALLOW** following geometry throughout:  
**NOT ALLOW** structures showing a simplified loop for ethanedioate ligands  
e.g. |
| (b) (i)  | Colourless to yellow ✓                                                                                                                                                                                | 1     | **IGNORE** clear for colourless  

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<tbody>
<tr>
<td>(b) (ii)</td>
<td>Mean titre 1 mark&lt;br&gt;$\frac{(23.15 + 23.25)}{2} = 23.2(0) \text{ cm}^3$ ✓</td>
<td>6</td>
<td>Common error:&lt;br&gt;Incorrect mean from all 3 titres = 23.30 cm$^3$&lt;br&gt;Use ECF throughout&lt;br&gt;Intermediate values for working to at least 3 SF.&lt;br&gt;TAKE CARE as value written down may be truncated value stored in calculator. Depending on rounding, either can be credited.&lt;br&gt;&lt;br&gt;---------------&lt;br&gt;COMMON ERRORS:&lt;br&gt;Mean of 23.30 (use of all 3 titres)&lt;br&gt;→ 0.634%: 5 marks&lt;br&gt;TAKE CARE for final answer of 0.63 seen.&lt;br&gt;• No final mark as only 2 SF&lt;br&gt;• 0.63 may have been rounded from 0.631 (from correct mean)&lt;br&gt;OR from 0.634 (using mean from all 3 titres)&lt;br&gt;Check back to mean titre.&lt;br&gt;No ÷2 to obtain $n((\text{COOH})_2)$&lt;br&gt;→ 1.26%: 5 marks from 23.20&lt;br&gt;→ 1.27%: 4 marks from 23.30</td>
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</tbody>
</table>
| 4(a)(i)  | +2     | 1     | ALLOW 2+ OR +II  
ALLOW Pt\(^{2+}\)  
ALLOW Pt–Cl bond  
Curly arrow from lone pair on NH\(_3\) to Pt ✓  
Curly arrow from any Pt–Cl bond in the complex ✓  |
| 4(a)(ii) |        | 2     | For [PtCl\(_3\)(NH\(_3\))]\(^{-}\):  
• IGNORE dipoles  
• IGNORE absence of – charge  
• IGNORE – charge shown on atoms  
ALLOW any 4 coordinate shape for [PtCl\(_3\)(NH\(_3\))]\(^{-}\),  
e.g. tetrahedral; ——Pt——  
1st curly arrow must  
• go to Pt  
AND  
start from, OR be traced back to any point across width of lone pair on N of NH\(_3\)  
2nd curly arrow must start from, OR be traced back to, any part of Pt–Cl bond and go to one of the 3 Cl atoms |

Mark curly arrows as above for S\(_{N1}\) mechanism:  
Mark curvy arrows as above for S\(_{N2}\)  
Requires + on platinum intermediate
<table>
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<tbody>
<tr>
<td>(b) (i)</td>
<td>Phenol ✓&lt;br&gt;Amide ✓&lt;br&gt;• IGNORE attempt to classify amide, e.g. secondary</td>
<td>2</td>
<td>IF &gt; 2 functional groups are shown,&lt;br&gt;• Mark 2 groups ONLY&lt;br&gt;• Mark incorrect groups first&lt;br&gt;Treat carbonyl with aldehyde OR with ketone as one functional group, i.e.&lt;br&gt;• carbonyl, aldehyde&lt;br&gt;• carbonyl, ketone&lt;br&gt;• carbonyl&lt;br&gt;IGNORE aryl OR alkyl group&lt;br&gt;• e.g. benzene, phenyl, aryl, arene, methyl&lt;br&gt;IGNORE hydroxyl/hydroxy</td>
</tr>
<tr>
<td>(b) (ii)*</td>
<td>Refer to marking instructions on page 5 of mark scheme for guidance on marking this question.</td>
<td>6</td>
<td>Indicative scientific points may include:&lt;br&gt;<strong>Calculation of mass of 4-nitrophenol</strong>&lt;br&gt;<strong>Using moles</strong>&lt;br&gt;• ( n(\text{paracetamol}) = \frac{5.00}{151} = 0.0331 ) (mol)&lt;br&gt;• ( n(4\text{-nitrophenol}) = \frac{0.0331 \times 100}{40} = 0.0828 ) (mol)&lt;br&gt;• Mass of 4-nitrophenol = 139 ( \times ) 0.0828 = 11.5 g&lt;br&gt;ALLOW 11.4–11.6 for small slip/rounding&lt;br&gt;<strong>Using mass</strong>&lt;br&gt;• Theoretical mass paracetamol = ( 5.00 \times \frac{100}{40} = 12.5 ) g&lt;br&gt;• Theoretical ( n(4\text{-nitrophenol}) = \frac{12.5}{151} = 0.0828 ) (mol)&lt;br&gt;• Mass of 4-nitrophenol = 139 ( \times ) 0.0828 = 11.5 g&lt;br&gt;NOTE: Incorrect inverse ratio of ( \frac{100}{40} ) gives:</td>
</tr>
<tr>
<td>Question</td>
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</table>
|          | Suggests reagents and intermediate with some omissions **AND** describes some purification steps, with some detail. |       | - $0.0331 \times \frac{40}{100} = 0.0132$ (mol) 
- Mass $= 139 \times 0.0132 = 1.84$ g |
|          | **There is a line of reasoning presented with some structure. The information presented is relevant and supported by some evidence.** |       | **Reagents and intermediate** |
|          | **Level 1 (1-2 marks)** | Attempts to calculate the mass of 4-nitrophenol | • Reagents: Sn + (conc) HCl (then NaOH) 
• Intermediate: 4-aminophenol or structure |
|          | OR Suggests reagents OR intermediate but may be incomplete | OR Describes few purification steps. | **Purification** |
|          | OR Describes few purification steps. | | • Dissolve impure solid in **minimum volume of** hot solvent 
• **Cool** solution and filter solid 
• **Scratch with glass rod** 
• Wash with cold solvent/solvent and dry |
<p>|          | <strong>There is an attempt at a logical structure with a line of reasoning. The information is in the most part relevant.</strong> | | <strong>Examples of detail in bold (NOT INCLUSIVE)</strong> |
|          | <strong>0 marks</strong> No response or no response worthy of credit. |       | <strong>NOTE:</strong> ‘Recrystallisation’ on its own is <strong>NOT</strong> a detailed description |
|          |                                  |       | <strong>Total</strong> 11 |</p>
<table>
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</tr>
</thead>
<tbody>
<tr>
<td>5 (a)</td>
<td><strong>TAKE CARE: Correct final answer of –52.3 OR –52.25 can be obtained from two cancelling errors:</strong>&lt;br&gt;• Use of 50 for energy released (no ×2 of 50 for two solutions mixed)&lt;br&gt;• No ÷ 2 in final step&lt;br&gt;–52.3 OR –52.25 would then be awarded 2 marks out of 4</td>
<td>4</td>
<td><strong>ALLOW ECF throughout</strong></td>
</tr>
</tbody>
</table>
|          | **Correctly calculates \( n(\text{succinic acid}) \)**<br>\[
\begin{align*}
0.400 \times \frac{50.0}{1000} &= 0.02(00) \text{ (mol)} \checkmark
\end{align*}
\] | | |
|          | **Energy released in J OR kJ**<br>\[
\begin{align*}
100.00 \times 4.18 \times 5.0 &= 2090 \text{ (J)} \checkmark
\end{align*}
\] | | **DO NOT ALLOW less than 3 SF**<br>**IGNORE units** |
|          | **Energy released, in kJ or J, for formation of 2 mol \( \text{H}_2\text{O} \)**<br>\[
\begin{align*}
\pm \frac{2090}{0.0200} &= \pm 104500 \text{ (J)}
\end{align*}
\] | | |
|          | **\( \Delta_{\text{neut}}H \) to 3 or more SF AND correct – sign**<br>\[
\begin{align*}
\Delta_{\text{neut}}H &= \frac{-104.5}{2} = -52.3 \text{ OR } -52.25 \text{ kJ mol}^{-1} \checkmark
\end{align*}
\] | | |
| 5 (b) (i) | **Titration** \( \checkmark \) | 1 | **IGNORE type of titration** |
| 5 (b) (ii) | (\( \text{CH}_2\text{COOH} \))\(_2 + 2\text{C}_2\text{H}_5\text{OH} \rightleftharpoons (\text{CH}_2\text{COOC}_2\text{H}_5)_2 + 2\text{H}_2\text{O} \checkmark \) | 1 | **ALLOW \( \rightarrow \) instead of \( \Rightarrow \) sign**

**ALLOW molecular formulae or hybrid formulae**

*Structures provided on QP*

\( \text{e.g. } \text{C}_4\text{H}_6\text{O}_4 + 2\text{C}_2\text{H}_5\text{O} \rightleftharpoons \text{C}_8\text{H}_{14}\text{O}_4 + 2\text{H}_2\text{O} \)
<table>
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</thead>
<tbody>
<tr>
<td>(iii)</td>
<td><img src="image" alt="Diagram" /> ✓</td>
<td>1</td>
<td><strong>IGNORE</strong> displayed formulae</td>
</tr>
<tr>
<td>(iv)</td>
<td>Volume cancels OR Same number of moles on each side of equation ✓</td>
<td>1</td>
<td><strong>ALLOW</strong> units cancel OR same number of (moles of) reactants and products <strong>IGNORE</strong> volume is the same; $K_c$ has no units</td>
</tr>
</tbody>
</table>
| (v)      | **Moles of equilibrium products** 1 mark  
$n((\text{CH}_2\text{COOC}_2\text{H}_5)_2) = 0.0300 \text{ (mol)}$ AND  
n$(\text{H}_2\text{O}) = 0.0600 \text{ (mol)}$ ✓  
Moles of C$_2$H$_5$OH 1 mark  
n$(\text{C}_2\text{H}_5\text{OH}) = 0.150 - 0.060 = 0.0900 \text{ (mol)}$ ✓  
$K_c$ calculated 1 mark  
$$
\begin{align*}
K_c & = \frac{0.03 \times 0.06^2}{0.02 \times 0.09^2} = 0.667 \text{ OR } 0.67 \checkmark \\
\text{NOTE: } 0.02 \text{ must be used for } n(\text{succinic acid})
\end{align*}
$$
| 3 | **ALLOW ECF**  
**ALLOW** 0.66, 0.666, etc. (2 SF and more)  
*Treated as meaning 0.6 recurring*  
**ALLOW** 2/3  
**IGNORE** any units |

**Total** 11
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</table>
| 6 (a) (i) | 3-hydroxybutanal ✓ | 1 | ALLOW 3-hydroxybutan-1-al
| | | | IGNORE lack of hyphens or addition of commas
| | | | ALLOW 4-oxobutan-2-ol OR 1-oxobutan-3-ol
| | | | DO NOT ALLOW
| | | | • 3-hydroxybutal
| | | | • 3-hydroxybutanal
| (ii) | Addition ✓ | 1 | IGNORE nucleophilic OR electrophilic OR radical
| | | | DO NOT ALLOW addition–elimination, condensation, polymerisation
| (iii) | ALLOW any formula provided that number and type of atoms and charge are correct, e.g. For CH$_3$CHO, ALLOW CH$_3$COH, C$_2$H$_4$O, etc. | 3 | Throughout, IGNORE 'connectivity in any formula or structures shown. Examples in Answer column and in 6a(iv) guidance below

**Step 1:**
- Correct equation ✓
- One correct acid–base pair ✓
  i.e. A1 and B1 OR A2 and B2
| | | |   | CH$_3$CHO + OH$^-$ ⇌ CH$_2$CHO + H$_2$O
| | | | OR | CH$_3$CHO + OH$^-$ ⇌ CH$_3$CO$^-$ + H$_2$O
| | | | A1 | B2 | B1 | A2
| | | | OR | A2 | B1 | B2 | A1

**Step 2:**
CH$_3$CHO + CH$_2$CHO + H$_2$O →
CH$_3$CHOHCH$_2$CHO + OH$^-$ ✓

**Step 1:** ALLOW H$^+$ transfer from OH$^-$,
  i.e.
| | | | | CH$_3$CHO + OH$^-$ ⇌ CH$_3$CH$_2$O$^+$ + O$^{2-}$ ✓
| | | | B2 | A1 | A2 | B1 ✓
| | | | OR | B1 | A2 | A1 | B2

**Step 2:**
CH$_3$CHO + CH$_3$CH$_2$O$^+$ + O$^{2-}$ →
CH$_3$CHOHCH$_2$CHO + OH$^-$ ✓
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<tr>
<th>Question</th>
<th>Answer</th>
<th>Marks</th>
<th>Guidance</th>
</tr>
</thead>
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| For $^\text{CH}_2\text{CHO}$: **ALLOW** $\text{CH}_2\text{CHO}$; $\text{CH}_3\text{CO}$; $\text{C}_2\text{H}_5\text{O}$
For $\text{CH}_3\text{CHOHCH}_2\text{CHO}$, **ALLOW** $\text{C}_4\text{H}_8\text{O}_2$

| (iv) | [Diagram of molecule] | 1 | **ALLOW** correct structural OR displayed OR skeletal formulae OR a combination of above as long as unambiguous
For connectivity,
**ALLOW** $| \quad | \quad \text{CH}_3– \quad \text{C}_3\text{H}– \quad \text{OH}–$

| (b) | Refer to marking instructions on page 5 of mark scheme for guidance on marking this question. | 6 | Indicative scientific points may include:
**Explanation of role of electrophiles in organic chemistry**

**Reaction of aliphatic compound and mechanism**
- Suitable reaction, e.g. ethene and $\text{Br}_2$
  *May be shown within mechanism*
- Mechanism, e.g.  

**Reaction of aromatic compound and mechanism**
- Suitable reaction, e.g. benzene + $\text{Cl}_2$; $\text{HNO}_3$
  *May be shown within mechanism*
- Mechanism, e.g.  


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</tr>
</thead>
<tbody>
<tr>
<td><strong>Level 1 (1–2 marks)</strong></td>
<td>Selects suitable reagents for electrophilic reactions of one aliphatic <strong>AND</strong> one aromatic compound. <strong>OR</strong> Attempts to describe an electrophilic reaction and mechanism of one aliphatic <strong>OR</strong> one aromatic compound, with omissions/errors. <strong>There is an attempt at a logical structure with a line of reasoning. The information is in the most part relevant.</strong></td>
<td>0 marks</td>
<td>No response or no response worthy of credit.</td>
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| **Total** | | 12 | Examples of a detailed description (NOT INCLUSIVE)  
  - Electrophile as electron pair acceptor  
  - Types and names of mechanisms  
  - Equations for generation of electrophile and regeneration of catalyst  
  - Accurately positioned and directed curly arrows and charges/ dipoles included  
  - Explanation of major and minor product from electrophilic addition |
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