

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

Annotation	Meaning
	Correct response
	Incorrect response
	Omission mark
	Benefit of doubt given
	Contradiction
	Rounding error
	Error in number of significant figures
	Error carried forward
	Level 1
	Level 2
	Level 3
	Benefit of doubt not given
	Noted but no credit given
	Ignore
	Blank page

Abbreviations, annotations and conventions used in the detailed Mark Scheme (to include abbreviations and subject-specific conventions).

Annotation	Meaning
DO NOT ALLOW	Answers which are not worthy of credit
IGNORE	Statements which are irrelevant
ALLOW	Answers that can be accepted
()	Words which are not essential to gain credit
BOLD	Emboldened words must be present in answer to score a mark
ECF	Error carried forward
AW	Alternative wording
ORA	Or reverse argument

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.

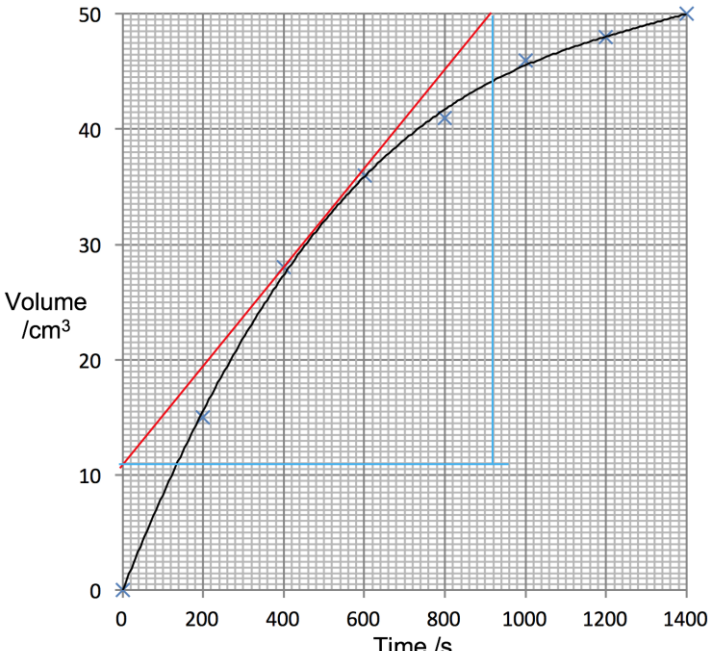
You should ensure that you have copies of these materials.

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.

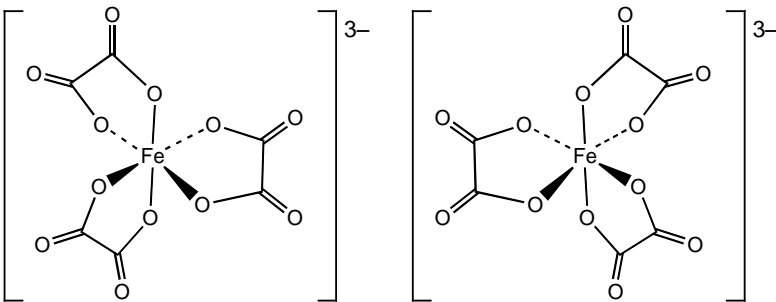
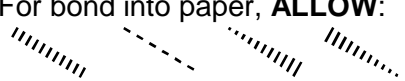
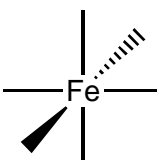
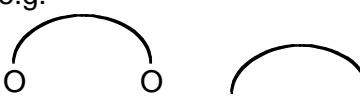
Question			Answer	Marks	Guidance
1	(a)	(i)	Hydrogen/H ✓	1	ALLOW H ₂
		(ii)	Helium/He ✓	1	
		(iii)	Magnesium/Mg ✓	1	
		(iv)	Sulfur/S ✓	1	ALLOW sulphur; S ₈
		(v)	Chlorine/Cl OR fluorine/F ✓	1	ALLOW Cl ₂ OR F ₂
		(vi)	Phosphorus/P ✓	1	ALLOW P ₄
		(vii)	Carbon/C ✓	1	ALLOW silicon/Si
		(viii)	Oxygen/O ✓	1	ALLOW O ₂

Question	Answer	Marks	Guidance
(b)	<p>NaCl OR MgCl₂ 2 marks Giant ionic OR ionic lattice ✓</p> <p>Ions are mobile in liquid state ✓</p> <hr/> <p>SiCl₄ OR PCl₃ OR SCl₂ 2 marks (Simple) molecular OR simple covalent (lattice) ✓</p> <p>Induced dipole(–dipole) forces/interactions OR London forces ✓</p> <hr/> <p>Comparison of bond strengths 1 mark</p> <ul style="list-style-type: none"> • Ionic bonds are stronger than London forces OR • Ionic bonds need more energy to break than London forces ✓ 	5	<p>IGNORE aqueous/dissolved ions are mobile IGNORE 'free ions' AND 'ions are free to carry current'</p> <hr/> <p>ALLOW 'are molecules'</p> <p>IGNORE</p> <ul style="list-style-type: none"> • permanent dipole(–dipole) forces • IDID and LDF • van der Waals <hr/> <p>ALLOW attraction between ions for ionic bonds ALLOW intermolecular forces for London forces ALLOW overcome for break</p> <p>ALLOW indirect comparison, i.e.</p> <ul style="list-style-type: none"> • 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
	Total	13	

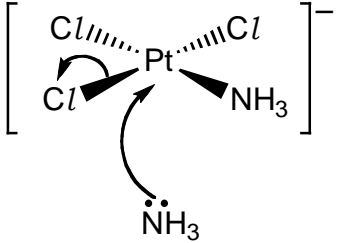
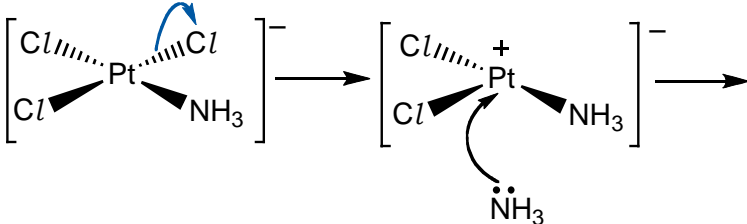
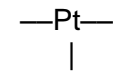
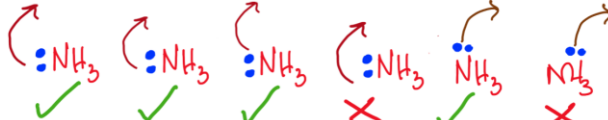
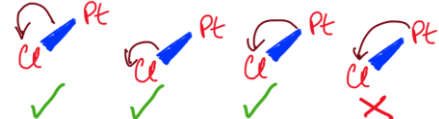
Question	Answer	Marks	Guidance
2 (a)	<p>Graph Graph of volume (y axis) against time (x axis) AND Axes labelled with correct units AND At least half graph paper in both directions AND Linear scales ✓</p> <p>Points 7 points from 200–1400 s plotted ✓ <i>Point at 0,0 not required</i></p> <p>Line Curve drawn through origin (0,0) ✓ AND Curve not drawn with straight lines between points.</p> <p>Rate Attempted tangent on graph drawn to curve at $t = 500 \pm 100$ s ✓</p> <p>Rate calculated in range 0.037–0.047 ($\text{cm}^3 \text{ s}^{-1}$) ✓ <i>e.g. for graph in guidance: $\frac{50 - 11}{920 - 0} = 0.042$</i></p> <hr/> <p>For tangents not drawn at 500 ± 100 s,</p> <ul style="list-style-type: none"> • ALLOW ECF ONLY for a tangent drawn to the candidate's line. • Then calculate the gradient from candidate's tangent. <p>For inverse graphs of time against volume,</p> <ul style="list-style-type: none"> • Graph mark will not be scored. • All other marks are available. • BUT rate = 1/ gradient = 0.037–0.047 ($\text{cm}^3 \text{ s}^{-1}$) 	5	 <p>ALLOW V OR Vol for volume ALLOW t for time For 's', ALLOW sec, seconds, etc</p> <p>CARE: Use of x and y coordinates at $t = 500$ s scores zero, <i>e.g. For volume = 33 cm^3 and time = 500 s, x and y coordinates gives $33/500 = 0.066$ ✗✗</i></p>

Question	Answer	Marks	Guidance
(ii)	<p>FIRST CHECK THE ANSWER ON ANSWER LINE If answer = 0.092 (mol dm⁻³) award 3 marks</p> <p>-----</p> $n(\text{O}_2) = \frac{55}{24000} = 2.29 \times 10^{-3} \text{ (mol) } \checkmark$ $n(\text{H}_2\text{O}_2) = 2.29 \times 10^{-3} \times 2 = 4.58 \times 10^{-3} \text{ (mol) } \checkmark$ $[\text{H}_2\text{O}_2] = \frac{4.58 \times 10^{-3} \times 1000}{50.0} = 0.092 \text{ (mol dm}^{-3}\text{)} \checkmark$ <p style="text-align: center;">(2 SF)</p>	3	<p>ALLOW ECF throughout</p> <p>ALLOW 2 SF up to calculator value of $2.291666667 \times 10^{-3}$</p> <p>ALLOW calculation using ideal gas equation provided that $p = \sim 10^5$ Pa and T in range 293–298 K. ALLOW use of 8.31 for R (gives same answer)</p> <p>e.g. $n(\text{O}_2) = \frac{1 \times 10^5 \times 55 \times 10^{-6}}{8.314 \times 298} = 2.22 \times 10^{-3} \text{ (mol) } \checkmark$</p> <p>$n(\text{H}_2\text{O}_2) = 2.22 \times 10^{-3} \times 2 = 4.44 \times 10^{-3} \text{ (mol) } \checkmark$</p> <p>$[\text{H}_2\text{O}_2] = \frac{4.44 \times 10^{-3} \times 1000}{50.0} = 0.089 \text{ (mol dm}^{-3}\text{)} \checkmark$</p> <p style="text-align: center;">(2 SF)</p> <p>NOTE: 293 K gives 0.090 (mol dm⁻³)</p> <p>Common errors 0.046 → 2 marks no × 2 for $n(\text{H}_2\text{O}_2)$</p>
(b)	$2\text{MnO}_4^- + 5\text{H}_2\text{O}_2 + 6\text{H}^+ \rightarrow 2\text{Mn}^{2+} + 8\text{H}_2\text{O} + 5\text{O}_2$ <p>Correctly balanced equation for $\text{MnO}_4^-/\text{H}_2\text{O}_2$ reaction but no cancelling of H^+ and/or e^- ✓</p> <p>Overall equation correct with all species cancelled ✓</p>	2	<p>ALLOW multiples</p> <p>ALLOW \rightleftharpoons instead of \rightarrow sign</p> <p>ALLOW 1 mark for final equation with correct balancing numbers AND</p> <p>ONE small slip in a formula OR charge</p> <p>IGNORE annotations around equations, i.e. treat as rough working</p> <p>ALLOW 1 mark for: $2\text{H}_2\text{O}_2 \rightarrow 2\text{H}_2\text{O} + \text{O}_2$ (H_2O_2 is acting as both reducing and oxidising agent)</p>

Question		Answer	Marks	Guidance
(c)	(i)	<p>Equation</p> $[\text{Co}(\text{H}_2\text{O})_6]^{2+} + 4\text{Cl}^- \rightleftharpoons [\text{CoCl}_4]^{2-} + 6\text{H}_2\text{O}$ <p>OR</p> $[\text{Co}(\text{H}_2\text{O})_6]^{2+} + 4\text{HCl} \rightleftharpoons [\text{CoCl}_4]^{2-} + 6\text{H}_2\text{O} + 4\text{H}^+ \checkmark$	1	<p>ALLOW reverse equation: $[\text{CoCl}_4]^{2-} + 6\text{H}_2\text{O} \rightleftharpoons [\text{Co}(\text{H}_2\text{O})_6]^{2+} + 4\text{Cl}^-$ but take care for subsequent explanations IGNORE state symbols (even if wrong)</p> <p>For $[\text{CoCl}_4]^{2-}$, ALLOW CoCl_4^{2-}, $(\text{CoCl}_4)^{2-}$ For other representations, contact TL</p>
	(ii)	<p>Equilibrium shift</p> <ul style="list-style-type: none"> equilibrium (shifts) to right at high temperature/100°C OR equilibrium shifts to left at low temperature/0°C ✓ <p>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.</p> <p>-----</p> <p>Enthalpy change</p> <ul style="list-style-type: none"> Endothermic ✓ 	2	<p>Mark independently</p> <p>ALLOW suitable alternatives for 'to right' e.g. towards products OR in forward direction OR 'favours the right' ORA for 'to left'</p> <p>Temperature required but ALLOW 'in ice for low temperature' OR 'in boiling/hot water' for high temperature</p> <p>IGNORE shift to blue side or pink side</p> <p>-----</p>
		Total	13	

Question	Answer	Marks	Guidance
3 (a)	<p>Overall 3- charge shown (outside brackets) for at least ONE isomer ✓ 3- must apply to the overall charge of structures</p>  <p>1 mark for each isomer ✓✓</p> <ul style="list-style-type: none"> • Bonds must go to O ligand atoms on EACH structure • ALLOW unambiguous structures; ethanedioate ions can include C atoms <p>For other structures that might be creditworthy, contact TL</p>	3	<p>ALLOW -3 for 3-</p> <p>IGNORE charges or dipoles on atoms within diagrams (even if wrong)</p> <p>Square brackets NOT required</p> <hr/> <p>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':</p> <p>For bond into paper, ALLOW:</p>  <p>ALLOW following geometry throughout:</p>  <p>NOT ALLOW structures showing a simplified loop for ethanedioate ligands e.g.</p> 
(b) (i)	Colourless to yellow ✓	1	IGNORE clear for colourless

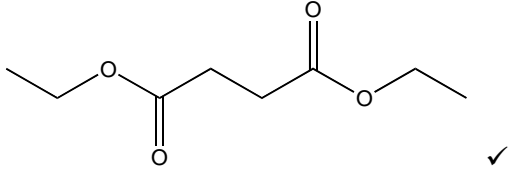
Question	Answer	Marks	Guidance
(b) (ii)	<p>Mean titre 1 mark</p> $= \frac{(23.15 + 23.25)}{2} = 23.2(0) \text{ (cm}^3\text{)} \checkmark$ <p>Analysis of results 5 marks</p> $n(\text{Ce}^{4+}) = 23.20 \times \frac{0.0500}{1000} = 1.16 \times 10^{-3} \text{ (mol)} \checkmark$ $n(\text{(COOH)}_2) \text{ in } 25.0 \text{ cm}^3 = \frac{1.16 \times 10^{-3}}{2} = 5.8(0) \times 10^{-4} \text{ (mol)} \checkmark$ $n(\text{(COOH)}_2) \text{ in } 250 \text{ cm}^3 = 5.8(0) \times 10^{-4} \times 10 = 5.8(0) \times 10^{-3} \text{ (mol)} \checkmark$ $\text{Mass (COOH)}_2 = 5.8(0) \times 10^{-3} \times 90.0 = 0.522 \text{ g} \checkmark$ $\% \text{ oxalic acid} = \frac{0.522 \times 100}{82.68} = 0.631\% \checkmark$ <p>Percentage MUST be expressed to 3 SF</p>	6	<p>Common error: Incorrect mean from all 3 titres = 23.30 cm³</p> <p>Use ECF throughout Intermediate values for working to at least 3 SF. TAKE CARE as value written down may be truncated value stored in calculator. Depending on rounding, either can be credited.</p> <p>-----</p> <p>COMMON ERRORS: Mean of 23.30 (use of all 3 titres) → 0.634%: 5 marks</p> <p>TAKE CARE for final answer of 0.63 seen.</p> <ul style="list-style-type: none"> • No final mark as only 2 SF • 0.63 may have been rounded from 0.631 (from correct mean) OR from 0.634 (using mean from all 3 titres) <p>Check back to mean titre.</p> <p>No ÷2 to <i>obtain</i> $n(\text{(COOH)}_2)$ → 1.26%: 5 marks from 23.20 → 1.27% 4 marks from 23.30</p>
	Total	10	

Question	Answer	Marks	Guidance
4 (a) (i)	+2 Sign required	1	ALLOW 2+ OR +II ALLOW Pt ²⁺
	<p>(ii)</p>  <p>Curly arrow from lone pair on NH₃ to Pt ✓</p> <p>[PtCl₃(NH₃)]⁻ drawn with 1 Pt, 3 Cls and 1 NH₃ AND Curly arrow from any Pt-Cl bond in the complex ✓</p> <p>ALLOW S_N1 mechanism:</p>  <p>Mark curly arrows as above for S_N2 Requires + on platinum intermediate</p>	2	<p>For [PtCl₃(NH₃)]⁻ :</p> <ul style="list-style-type: none"> • IGNORE dipoles • IGNORE absence of - charge • IGNORE - charge shown on atoms <p>ALLOW any 4 coordinate shape for [PtCl₃(NH₃)]⁻, e.g. tetrahedral; </p> <p>1st curly arrow must</p> <ul style="list-style-type: none"> • go to Pt <p>AND start from, OR be traced back to any point across width of lone pair on N of NH₃</p>  <p>DO NOT ALLOW charge on NH₃ nucleophile, e.g. NH₃⁻</p> <p>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</p> 

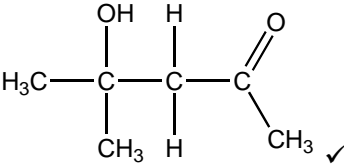
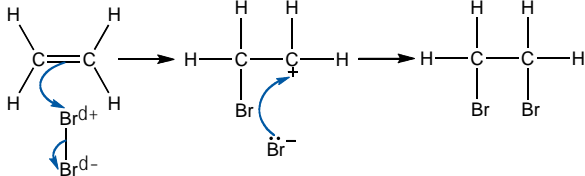
Question		Answer	Marks	Guidance
(b)	(i)	Phenol ✓ Amide ✓ • IGNORE attempt to classify amide, e.g. secondary	2	IF > 2 functional groups are shown, • Mark 2 groups ONLY • Mark incorrect groups first Treat carbonyl with aldehyde OR with ketone as one functional group, i.e. • carbonyl, aldehyde • carbonyl, ketone • carbonyl IGNORE aryl OR alkyl group e.g. benzene, phenyl, aryl, arene, methyl IGNORE hydroxyl/hydroxy
(b)	(ii)*	<p><i>Refer to marking instructions on page 5 of mark scheme for guidance on marking this question.</i></p> <p>Level 3 (5-6 marks) A correct calculation of the mass of 4-nitrophenol. AND Identifies the reagents AND intermediate. AND A detailed description of most purification steps.</p> <p><i>There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.</i></p> <p>Level 2 (3-4 marks) Calculates the mass of 4-nitrophenol with some errors AND suggests reagents and intermediate with some omissions. OR Calculates the mass of 4-nitrophenol with some errors AND describes some purification steps, with some detail. OR</p>	6	<p>Indicative scientific points may include: <u>Calculation of mass of 4-nitrophenol</u> Using moles</p> <ul style="list-style-type: none"> $n(\text{paracetamol}) = \frac{5.00}{151} = 0.0331 \text{ (mol)}$ $n(4\text{-nitrophenol}) = 0.0331 \times \frac{100}{40} = 0.0828 \text{ (mol)}$ Mass of 4-nitrophenol = $139 \times 0.0828 = 11.5 \text{ g}$ <p>ALLOW 11.4–11.6 for small slip/rounding</p> <p>Using mass</p> <ul style="list-style-type: none"> Theoretical mass paracetamol = $5.00 \times \frac{100}{40} = 12.5 \text{ g}$ Theoretical $n(4\text{-nitrophenol}) = \frac{12.5}{151} = 0.0828 \text{ (mol)}$ Mass of 4-nitrophenol = $139 \times 0.0828 = 11.5 \text{ g}$ <p>NOTE: Incorrect inverse ratio of $\frac{100}{40}$ gives:</p>

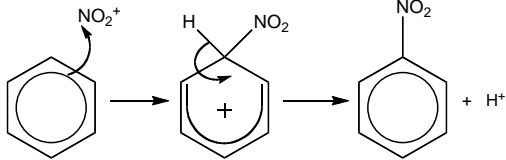
Question	Answer	Marks	Guidance
	<p>Suggests reagents and intermediate with some omissions AND describes some purification steps, with some detail.</p> <p><i>There is a line of reasoning presented with some structure. The information presented is relevant and supported by some evidence.</i></p> <p>Level 1 (1-2 marks) Attempts to calculate the mass of 4-nitrophenol OR Suggests reagents OR intermediate but may be incomplete OR Describes few purification steps.</p> <p><i>There is an attempt at a logical structure with a line of reasoning. The information is in the most part relevant.</i></p> <p>0 marks No response or no response worthy of credit.</p>		<ul style="list-style-type: none"> • $0.0331 \times \frac{40}{100} = 0.0132$ (mol) • Mass = $139 \times 0.0132 = 1.84$ g <p>Reagents and intermediate</p> <ul style="list-style-type: none"> • Reagents: Sn + (conc) HCl (then NaOH) • Intermediate: 4-aminophenol or structure <p>Purification</p> <ul style="list-style-type: none"> • 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>Examples of detail in bold (NOT INCLUSIVE)</p> <p>NOTE: 'Recrystallisation' on its own is NOT a detailed description</p>
	Total	11	

Question	Answer	Marks	Guidance
5 (a)	<p>TAKE CARE: Correct final answer of –52.3 OR –52.25 can be obtained from two cancelling errors:</p> <ul style="list-style-type: none"> • Use of 50 for energy released (no $\times 2$ of 50 for two solutions mixed) • No $\div 2$ in final step <p>–52.3 OR –52.25 would then be awarded 2 marks out of 4</p> <p>-----</p> <p>Correctly calculates $n(\text{succinic acid})$</p> $= 0.400 \times \frac{50.0}{1000} = 0.02(00) \text{ (mol) } \checkmark$ <p>Energy released in J OR kJ</p> $= 100.00 \times 4.18 \times 5.0 = 2090 \text{ (J) OR } 2.090 \text{ (kJ) } \checkmark$ <p>Energy released, in kJ or J, for formation of 2 mol H₂O</p> $\pm \frac{2090}{0.0200} = \pm 104500 \text{ (J)}$ <p>OR</p> $\pm \frac{2.090}{0.0200} = \pm 104.5 \text{ OR } \pm 105 \text{ (kJ) } \checkmark$ <p>$\Delta_{\text{neut}}H$ to 3 or more SF AND correct – sign</p> $= -\frac{104.5}{2} = -52.3 \text{ OR } -52.25 \text{ kJ mol}^{-1} \checkmark$	4	<p>ALLOW ECF throughout</p> <p>DO NOT ALLOW less than 3 SF IGNORE units</p> <p>-----</p> <p>ALTERNATIVE METHOD</p> <p>$n(\text{succinic acid}) = 0.02(00) \text{ (mol) } \checkmark$</p> <p>Energy released = 2090 (J) OR 2.090 (kJ) \checkmark</p> <p>$n(\text{H}_2\text{O}) \text{ formed} = 2 \times 0.02(00) = 0.04(00) \text{ (mol) } \checkmark$</p> <p>$\Delta_{\text{neut}}H = -\frac{2.090}{0.0400} = -52.3 \text{ OR } -52.25 \text{ kJ mol}^{-1} \checkmark$</p>
(b) (i)	Titration \checkmark	1	IGNORE type of titration
(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	<p>ALLOW \rightarrow instead of \rightleftharpoons sign</p> <p>ALLOW molecular formulae or hybrid formulae <i>Structures provided on QP</i> e.g. $\text{C}_4\text{H}_6\text{O}_4 + 2\text{C}_2\text{H}_6\text{O} \rightleftharpoons \text{C}_8\text{H}_{14}\text{O}_4 + 2\text{H}_2\text{O}$</p>

Question	Answer	Marks	Guidance
(iii)		1	IGNORE displayed formulae
(iv)	Volume cancels OR Same number of moles on each side of equation ✓	1	ALLOW units cancel ALLOW (sum of) balancing numbers/coefficients on each side of equation are the same OR same number of (moles of) reactants and products IGNORE volume is the same; K_c has no units
(v)	<p>Moles of equilibrium products 1 mark $n(\text{CH}_2\text{COOC}_2\text{H}_5)_2 = 0.0300 \text{ (mol)}$ AND $n(\text{H}_2\text{O}) = 0.0600 \text{ (mol)}$ ✓</p> <p>Moles of C₂H₅OH 1 mark $n(\text{C}_2\text{H}_5\text{OH}) = 0.150 - 0.060 = 0.0900 \text{ (mol)}$ ✓</p> <p>K_c calculated 1 mark $= \frac{0.03 \times 0.06^2}{0.02 \times 0.09^2} = 0.667 \text{ OR } 0.67$ ✓ NOTE: 0.02 must be used for $n(\text{succinic acid})$</p>	3	ALLOW ECF ALLOW 0.66, 0.666, etc. (2 SF and more) <i>Treated as meaning 0.6 recurring</i> ALLOW 2/3 IGNORE any units
	Total	11	

Question			Answer	Marks	Guidance
6	(a)	(i)	3-hydroxybutanal ✓	1	<p>ALLOW 3-hydroxybutan-1-al</p> <p>IGNORE lack of hyphens or addition of commas</p> <p>ALLOW 4-oxobutan-2-ol OR 1-oxobutan-3-ol</p> <p>DO NOT ALLOW</p> <ul style="list-style-type: none"> 3-hydroxybutal 3-hydroxybutanal
		(ii)	Addition ✓	1	<p>IGNORE nucleophilic OR electrophilic OR radical</p> <p>DO NOT ALLOW addition–elimination, condensation, polymerisation</p>
		(iii)	<p>ALLOW any formula provided that number and type of atoms and charge are correct, e.g. For CH₃CHO, ALLOW CH₃COH, C₂H₄O, etc.</p> <p>-----</p> <p>Step 1:</p> <ul style="list-style-type: none"> Correct equation ✓ One correct acid–base pair ✓ i.e. A1 and B1 OR A2 and B2 $\begin{array}{ccccccc} \text{CH}_3\text{CHO} & + & \text{OH}^- & \rightleftharpoons & ^-\text{CH}_2\text{CHO} & + & \text{H}_2\text{O} \\ \text{OR} & & & & & & \\ \text{CH}_3\text{CHO} & + & \text{OH}^- & \rightleftharpoons & \text{CH}_3\text{CO}^- & + & \text{H}_2\text{O} \\ & \text{A1} & \text{B2} & & \text{B1} & \text{A2} & \\ \text{OR} & & & & & & \\ & \text{A2} & \text{B1} & & \text{B2} & \text{A1} & \end{array}$ <p>Step 2:</p> $\text{CH}_3\text{CHO} + ^-\text{CH}_2\text{CHO} + \text{H}_2\text{O} \rightarrow \text{CH}_3\text{CHOHCH}_2\text{CHO} + \text{OH}^- \checkmark$	3	<p>Throughout, IGNORE 'connectivity in any formula or structures shown.</p> <p>Examples in Answer column and in 6a(iv) guidance below</p> <p>-----</p> <p>Step 1: ALLOW H⁺ transfer from OH⁻, i.e.</p> $\begin{array}{ccccccc} \text{CH}_3\text{CHO} & + & \text{OH}^- & \rightleftharpoons & \text{CH}_3\text{CH}_2\text{O}^+ & + & \text{O}^{2-} \checkmark \\ & \text{B2} & \text{A1} & & \text{A2} & \text{B1} & \checkmark \\ \text{OR} & & & & & & \\ & \text{B1} & \text{A2} & & \text{A1} & \text{B2} & \end{array}$ <p>Step 2:</p> $\text{CH}_3\text{CHO} + \text{CH}_3\text{CH}_2\text{O}^+ + \text{O}^{2-} \rightarrow \text{CH}_3\text{CHOHCH}_2\text{CHO} + \text{OH}^- \checkmark$

Question	Answer	Marks	Guidance
	For $^-CH_2CHO$: ALLOW CH_2CHO^- ; CH_3CO^- ; $C_2H_3O^-$ For $CH_3CHOHCH_2CHO$, ALLOW $C_4H_8O_2$		For $CH_3CH_2O^+$: ALLOW CH_3CHOH^+ , $C_2H_5O^+$
(iv)		1	ALLOW correct structural OR displayed OR skeletal formulae OR a combination of above as long as unambiguous For connectivity, ALLOW $\begin{array}{ccccccc} & & CH_3- & & C_3H- & & OH- \\ OH & CH_3 & & & & & \end{array}$ (Connectivity not being assessed)
(b)	<p>Refer to marking instructions on page 5 of mark scheme for guidance on marking this question.</p> <p>Level 3 (5–6 marks) Describes, in detail, electrophilic reactions and mechanisms of one aliphatic AND one aromatic compound. <i>There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.</i></p> <p>Level 2 (3–4 marks) Describes, in detail, an electrophilic reaction and mechanism of one aliphatic OR one aromatic compound. OR Describes electrophilic reactions and mechanisms of one aliphatic AND one aromatic compound, with few omissions/errors. <i>There is a line of reasoning presented with some structure. The information presented is relevant and supported by some evidence.</i></p>	6	<p>Indicative scientific points may include:</p> <p><u>Explanation of role of electrophiles in organic chemistry</u></p> <p><u>Reaction of aliphatic compound and mechanism</u></p> <ul style="list-style-type: none"> Suitable reaction, e.g. ethene and Br_2 <i>May be shown within mechanism</i> Mechanism, e.g.  <p><u>Reaction of aromatic compound and mechanism</u></p> <ul style="list-style-type: none"> Suitable reaction, e.g. benzene + Cl_2; HNO_3 <i>May be shown within mechanism</i> Mechanism, e.g.

Question	Answer	Marks	Guidance
	<p>Level 1 (1–2 marks) Selects suitable reagents for electrophilic reactions of one aliphatic AND one aromatic compound. OR Attempts to describe an electrophilic reaction and mechanism of one aliphatic OR one aromatic compound, with omissions/errors.</p> <p><i>There is an attempt at a logical structure with a line of reasoning. The information is in the most part relevant.</i></p> <p>0 marks No response or no response worthy of credit.</p>		 <p>Examples of a detailed description (NOT INCLUSIVE)</p> <ul style="list-style-type: none"> • 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
Total		12	

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