

OCR

Oxford Cambridge and RSA

Practice paper – Set 1

A Level Chemistry B

H433/02 Scientific Literacy in Chemistry

MARK SCHEME

Duration: 2 hours 15 minutes

MAXIMUM MARK 100

Final

This document consists of 16 pages

MARKING INSTRUCTIONS**PREPARATION FOR MARKING****SCORIS**

1. Make sure that you have accessed and completed the relevant training packages for on-screen marking: *scoris assessor Online Training*; *OCR Essential Guide to Marking*.
2. Make sure that you have read and understood the mark scheme and the question paper for this unit. These are posted on the RM Cambridge Assessment Support Portal <http://www.rm.com/support/ca>
3. Log-in to scoris and mark the **required number** of practice responses (“scripts”) and the **required number** of standardisation responses.

YOU MUST MARK 10 PRACTICE AND 10 STANDARDISATION RESPONSES BEFORE YOU CAN BE APPROVED TO MARK LIVE SCRIPTS.

MARKING

1. Mark strictly to the mark scheme.
2. Marks awarded must relate directly to the marking criteria.
3. The schedule of dates is very important. It is essential that you meet the scoris 50% and 100% (traditional 50% Batch 1 and 100% Batch 2) deadlines. If you experience problems, you must contact your Team Leader (Supervisor) without delay.
4. If you are in any doubt about applying the mark scheme, consult your Team Leader by telephone, email or via the scoris messaging system.

5. Work crossed out:
- a. where a candidate crosses out an answer and provides an alternative response, the crossed out response is not marked and gains no marks
 - b. if a candidate crosses out an answer to a whole question and makes no second attempt, and if the inclusion of the answer does not cause a rubric infringement, the assessor should attempt to mark the crossed out answer and award marks appropriately.
6. Always check the pages (and additional objects if present) at the end of the response in case any answers have been continued there. If the candidate has continued an answer there then add a tick to confirm that the work has been seen.
7. There is a NR (No Response) option. Award NR (No Response)
- if there is nothing written at all in the answer space
 - OR if there is a comment which does not in any way relate to the question (e.g. 'can't do', 'don't know')
 - OR if there is a mark (e.g. a dash, a question mark) which isn't an attempt at the question.

Note: Award 0 marks – for an attempt that earns no credit (including copying out the question).

8. The scoris **comments box** is used by your Team Leader to explain the marking of the practice responses. Please refer to these comments when checking your practice responses. **Do not use the comments box for any other reason.**
- If you have any questions or comments for your Team Leader, use the phone, the scoris messaging system, or email.
9. Assistant Examiners will send a brief report on the performance of candidates to their Team Leader (Supervisor) via email by the end of the marking period. The report should contain notes on particular strengths displayed as well as common errors or weaknesses. Constructive criticism of the question paper/mark scheme is also appreciated.

10. For answers marked by levels of response:

Read through the whole answer from start to finish, concentrating on features that make it a stronger or weaker answer using the indicative scientific content as guidance. The indicative scientific content indicates the expected parameters for candidates' answers, but be prepared to recognise and credit unexpected approaches where they show relevance.

Using a 'best-fit' approach based on the science content of the answer, first decide which set of level descriptors, Level 1, Level 2 or Level 3, **best** describes the overall quality of the answer using the guidelines described in the level descriptors in the mark scheme.

Once the level is located, award the higher or lower mark.

The higher mark should be awarded where the level descriptor has been evidenced and all aspects of the communication statement (in italics) have been met.

The lower mark should be awarded where the level descriptor has been evidenced but aspects of the communication statement (in italics) are missing.

In summary:

- **The science content determines the level.**
- **The communication statement determines the mark within a level.**

Level of response questions on this paper are **3di** and **5g**.

11. Annotations

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
—	Underlined words must be present in answer to score a mark
ECF	Error carried forward
AW	Alternative wording
ORA	Or reverse argument

12. Subject-specific Marking Instructions

INTRODUCTION

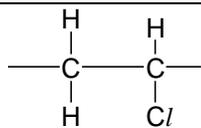
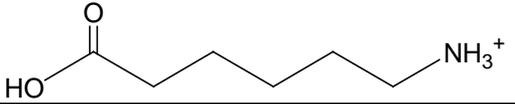
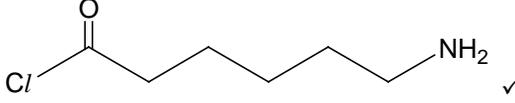
Your first task as an Examiner is to become thoroughly familiar with the material on which the examination depends. This material includes:

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

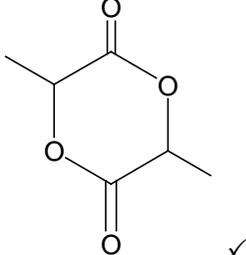
You should ensure that you have copies of these materials.

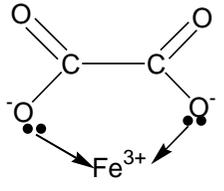
You should ensure also that you are familiar with the administrative procedures related to the marking process. These are set out in the OCR booklet **Instructions for Examiners**. If you are examining for the first time, please read carefully **Appendix 5 Introduction to Script Marking: Notes for New 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)	chloroethene	1	
		(ii)		1	Must be skeletal formulae BOTH structures required for the mark
		(iii)	(bubble through) bromine water – decolorised	1	ALLOW 'brown/orange to colourless'
	(b)	(i)		1	Must be full structural, showing all bonds and atoms IGNORE brackets and 'n'
		(ii)	permanent (dipole) - permanent dipole	1	no abbreviation ALLOW missing hyphen
	(c)	(i)	secondary amide	1	
		(ii)	six C atoms between functional groups/ links AW	1	ALLOW 'six carbon atoms'
		(iii)	no water/small molecule produced ✓ addition ✓	2	
		(iv)	hydrogen bonding ✓ between NH and O/N ✓ stronger than pd-pd ✓ more energy to break ✓	4	For mpt 3, allow incorrect imb from (b)(ii)
	(d)	(i)	hydrochloric/ sulfuric acid ✓ (heat under) reflux ✓	2	
		(ii)		1	ALLOW any unambiguous structure IGNORE anions
		(iii)	 acid/acyl chloride ✓	2	ALLOW any unambiguous structure For second mark ALLOW primary amine if carboxylic acid is shown on left of molecule.
			Total	18	

Question		Answer	Marks	Guidance
2	(a)	$2\text{RCONH}_2 + \text{H}_2\text{SO}_4 + 2\text{H}_2\text{O} \rightarrow 2\text{RCOOH} + (\text{NH}_4)_2\text{SO}_4$ species ✓ balancing with correct species ✓	2	IGNORE state symbols ALLOW multiples and halves
	(b) (i)	$\text{NH}_4^+ \rightleftharpoons \text{NH}_3 + \text{H}^+$ acid base	1	IGNORE 'conjugate'
	(ii)	$[\text{NH}_3][\text{H}^+]/[\text{NH}_4^+]$	1	ALLOW dot or multiplication sign on top IGNORE correct state symbols. Incorrect ones are CON
	(iii)	FIRST CHECK ANSWER ON ANSWER LINE IF $K_a = 5.5 \times 10^{-10} \text{ mol dm}^{-3}$ award 3 marks IF $K_a = 5.5 \times 10^{-10}$ with incorrect or missing units, award 2 marks $[\text{H}^+]$ (or $\text{H}^+ = 7.4(13102) \times 10^{-6}$ ✓ $K_a = (7.41 \times 10^{-6})^2 / 0.1 = 5.5 \times 10^{-10}$ ✓ mol dm^{-3} ✓	3	ALLOW ECF from first marking point, provided ' $[\text{H}^+] =$ ' or ' $\text{H}^+ =$ ' is shown and value is smaller than 1×10^{-4} ALLOW 2 or more sf
	(iv)	FIRST CHECK ANSWER ON ANSWER LINE IF $K_b = 1.8 \times 10^{-5} (\text{mol dm}^{-3})$ award 2 marks $K_a \times K_b = K_w$ OR $K_b = K_w/K_a$ ✓ $K_b (= 1.0 \times 10^{-14} / 5.5 \times 10^{-10}) = 1.8 \times 10^{-5} (\text{mol dm}^{-3})$ ✓	2	ALLOW ECF from (iii) ALLOW 2 or more sf
	(c) (i)	FIRST CHECK ANSWER ON ANSWER LINE IF answer = 0.386(g) award 3 marks $[\text{lactate}] = 1.38 \times 10^{-4} \times 0.01 / 1 \times 10^{-4}$ OR 0.0138 ✓ amount lactate = 0.0138/4 OR 3.45×10^{-3} (mol) ✓ mass sodium lactate = $(3.45 \times 10^{-3} \times 112 =)$ 0.386 (g) ✓	3	ALLOW 2 or more sf.

Question	Answer	Marks	Guidance
	(ii) Incorrect, because the ratio of the concentrations will remain the same (whatever the volume)	1	DO NOT ALLOW 'incorrect' without an explanation
	(d) OH/alcohol group reacts with COOH/acid group ✓ OR two molecules react/condense to lose (two molecules of) water ✓ 	2	ALLOW any correct representation of structure.
	Total	15	

Question			Answer	Marks	Guidance
3	(a)	(i)	 <p>lone pairs as shown, linking to some drawn line to represent the bond ✓ two bonds shown as arrows from O⁻ pointing to one Fe³⁺ ✓ dative covalent/co-ordinate bond labelled ✓</p>	3	
		(ii)	$[\text{Fe}(\text{C}_2\text{O}_4)_3]^{3-}$ ✓ octahedral ✓	2	ALLOW without square brackets ALLOW structural formula
	(b)	(i)	<p>The E^\ominus of $\text{CO}_2/(\text{COOH})_2$ half cell is more negative/less positive than that of the $\text{Fe}^{3+}/\text{Fe}^{2+}$ half cell</p> <p>$(\text{COOH})_2$ will release electrons/reduce Fe^{3+} OR Fe^{3+} will gain electrons/ oxidise $(\text{COOH})_2$ ✓</p>	2	ALLOW abbreviated descriptions of half cells as 'Fe ³⁺ ' etc (since there are only two of them) IGNORE 'greater than', 'less than'
		(ii)	$2\text{Fe}^{3+} + (\text{COOH})_2 \rightarrow 2\text{Fe}^{2+} + 2\text{CO}_2 + 2\text{H}^+$ species ✓ balancing with correct species ✓	2	
		(iii)	<p>Fe^{2+} double arrow in one 3d box, single arrows (same direction) in the other 3d boxes. 4s box empty ✓</p> <p>Fe^{3+} single arrows in all 3d boxes (same direction). 4s box empty ✓</p>	2	

Question		Answer	Marks	Guidance												
(c)	(i)	<table border="1"> <tr> <td>Mn</td> <td>MnO_4^-</td> <td>Mn^{2+}</td> </tr> <tr> <td>oxidation states</td> <td>+7</td> <td>+2</td> </tr> </table> <table border="1"> <tr> <td>C</td> <td>$\text{C}_2\text{O}_4^{2-}$</td> <td>$\text{CO}_2$</td> </tr> <tr> <td>oxidation states</td> <td>+3</td> <td>+4</td> </tr> </table> <p>✓✓1 mark for either one row or one column correct</p>	Mn	MnO_4^-	Mn^{2+}	oxidation states	+7	+2	C	$\text{C}_2\text{O}_4^{2-}$	CO_2	oxidation states	+3	+4	2	
Mn	MnO_4^-	Mn^{2+}														
oxidation states	+7	+2														
C	$\text{C}_2\text{O}_4^{2-}$	CO_2														
oxidation states	+3	+4														
	(ii)	<p>oxidation state increase of C is +10 oxidation state decrease of Mn is -10</p>	1	because the oxidation state decrease of manganese must equal the increase of C												
(d)	(i)*	<p><i>First please read the instructions for marking 'Level of Response' mark-schemes on page 4</i></p> <p>Level 3 (5 – 6 marks) Learners analyse the information from the stem of the question to develop and refine the practical procedure and evaluate the use of the indicator, making most of the scientific points. <i>The explanation is relevant and logically structured and contains no errors.</i></p> <p>Level 2 (3 – 4 marks) Learners partially analyse the information from the stem of the question to develop and refine the practical procedure and evaluate the use of the indicator, making some of the scientific points. <i>The explanation is generally relevant and logically structured and contains few errors.</i></p> <p>Level 1 (1 – 2 marks) Learners show some ability to analyse the information from the stem of the question to develop and refine the practical procedure and evaluate the use of the indicator, making a few of the scientific points.</p>	6	<p>indicative scientific points may include:</p> <p>titration</p> <ul style="list-style-type: none"> manganate(VII) (solution) in burette pipette known/stated volume of ethanedioate OR use graduated/volumetric pipette for ethanedioate. add sulfuric acid some indication that sulfuric acid is in excess warm/heat solution/ 60°C titrate (AW) until pink colour persists/ remains (AW) add (manganate(VII)) dropwise (AW) near end repeat for concordance (AW) <p>indicator</p> <ul style="list-style-type: none"> MnO_4^{2-}/manganate(VII) is only coloured reagent colour change takes place during reaction from colourless to pale pink 												

Question		Answer	Marks	Guidance
		<i>A partial explanation is attempted and has some structure.</i> Level 0 (no marks) No response or no response worthy of credit		
	(ii)	FIRST CHECK ANSWER ON ANSWER LINE IF answer = 1.69(g) award 5 marks <ul style="list-style-type: none"> • amount KMnO_4 used = $18.4/1000 \times 0.0500$ OR 0.0009200 (mol) ✓ • amount potassium ethanedioate used = $5/2 \times 0.0009200$ OR 0.002300 (mol) ✓ • amount in $0.100 \text{ dm}^3 = 4 \times 0.002300$ OR 0.009200(mol) ✓ • mass $\text{K}_2\text{C}_2\text{O}_4 \cdot \text{H}_2\text{O} = 184(.2) \times 0.009200$ OR 1.69(...) (g) ✓ • answer = 1.69 (3 sf) (g)✓ 	5	ALLOW ECF throughout
(e)	(i)	Ethane-1,2-diol	1	ALLOW ethanediol
	(ii)	OH group bonded to C with 2H or 1C	1	IGNORE 'it' for OH group but ALLOW 'alcohol group' for OH group
(f)	(i)	aldehyde	1	
	(ii)	EITHER Warm with Tollens' reagent / silver mirror ✓ OR Heat with Fehling's solution / Red ppt ✓	2	ALLOW chemical descriptions of Tollens' or Fehling's. Second mark depends on reagent being identified
Total			30	

Question		Answer	Marks	Guidance
4	(a)	<p>temp: increased yield/ more products ✓ forward reaction [stated or implied] is <u>endothermic</u> (ora) ✓</p> <p>pressure: no effect on yield AW ✓ same number of (gaseous) moles/ molecules on each side (of equation) AW ✓</p>	4	<p>ALLOW 'it increases' IGNORE 'equilibrium (position) moves to right'</p> <p>ALLOW 'no effect on <u>position</u> of equilibrium' ALLOW 'no change of yield'/'no increase of yield' NOT 'little effect on yield' etc</p> <p>No ecf but mark separately within each pair.</p>
	(b)	<p>speeds up achievement of equilibrium OR speeds up both (forward and back) reactions ✓</p> <p>no effect on K_c (AW) ✓</p>	2	Can score this alternative for the first marking point while explaining effect on K_c
	(c)	<p>FIRST CHECK ANSWER ON ANSWER LINE IF $K_a = 9.39 \times 10^{-7}$ (mol dm⁻³) award 4 marks</p> $\text{H}_2(\text{g}) + \text{CO}_2(\text{g}) \rightleftharpoons \text{H}_2\text{O}(\text{g}) + \text{CO}(\text{g})$ <p>init Both 1.16×10^{-5} eqm Both $1.16 \times 10^{-5} - x$ x x ✓</p> <p>$\sqrt{K_c} = x/(1.16 \times 10^{-5} - x)$ ✓</p> <p>$x = \sqrt{7.76 \times 10^{-3}(1.16 \times 10^{-5} - x)}$ or $x = 0.088(1.16 \times 10^{-5} - x)$ ✓</p> <p>($1.088x = 1.02 \times 10^{-6}$ so) $x = 9.39 \times 10^{-7}$ (mol dm⁻³) ✓</p>	4	<p><i>First marking point:</i> some indication of how concentrations of products linked to remaining concentration of reactants</p> <p><i>Second:</i> relation of concs to K_c</p> <p><i>Third:</i> rearrangement of formula</p> <p><i>Fourth:</i> value of x.</p> <p>ALLOW 9.38×10^{-7} from early rounding If answer is correct on answer line, award 4 marks without reference to working. 1.02×10^{-6} (treating initial concentrations as equilibrium ones) scores 2</p>
	(d)	(i)	1	ALLOW 'uv'
		(ii)	1	any mention of oxygen that makes sense

Question		Answer	Marks	Guidance
				IGNORE references to CO ₂ and/or hydrogen
	(e)	$\Delta H_2 = (198 + 189 - 214 - 42) = +131 \text{ (J mol}^{-1} \text{ K}^{-1}) \checkmark$	1	
	(f) (i)	FIRST CHECK ANSWER ON ANSWER LINE IF $\Delta_{\text{tot}}S = +10.6 \text{ (J mol}^{-1} \text{ K}^{-1})$ award 2 marks $T = 1273 \text{ K } \checkmark$ $\Delta_{\text{tot}}S = (42 - 40000/1273) = +10.6 \text{ (J mol}^{-1} \text{ K}^{-1}) \checkmark$	2	ALLOW two or more sf.(common rounding +11)
	(ii)	Reaction is feasible \checkmark Sign is positive for $\Delta_{\text{tot}}S \checkmark$	2	ALLOW 'spontaneous' or 'goes' or 'possible'
		Total	17	

Question			Answer	Marks	Guidance
5	(a)	(i)	2,6-dichloro-3,5-diethylphenol	1	Ignore, commas, dashes and gaps
		(ii)	greater activity since longer alkyl groups OR less toxic (when taken by mouth) since more substitution	1	must have reason as well as effect to score
		(iii)	activity decreases since no halogen in 4 position ✓ less soluble since more substituted ✓	2	must have reason as well as effect to score two correct effects alone score 1 mark
	(b)		(aromatic compounds have) delocalised electrons that are lost on addition AND retained on substitution ✓ (loss of delocalisation causes) less stability AW ✓	2	
	(c)		-OH hydrogen bonds to N/N-H/O on protein	1	
	(d)		anion is more stable ✓ overlap of p-orbital on chlorine with delocalised/ π electrons of ring ✓	2	Answers can be in either order Idea of negative charge of anion being spread over the delocalised system and Cl side group
	(e)		(water) hydrogen bonds ✓ (non-polar) instantaneous dipole-induced dipole ✓	2	must be spelled correctly, no abbreviations
	(f)		FIRST CHECK ANSWER ON ANSWER LINE IF pH = 6.19 award 3 marks conc of PCMX = 0.330/156.6 OR 2.1073×10^{-3} (mol dm ⁻³) ✓ [H ⁺] = $\sqrt{(1.99 \times 10^{-10} \times 2.1073 \times 10^{-3})}$ OR 6.4757×10^{-7} (mol dm ⁻³) ✓ pH = 6.19 ✓	3	ALLOW ECF from each stage ALLOW 6.2 ALLOW 2 or more sf
	(g)		<i>First please read the instructions for marking 'Level of Response' mark-schemes on page 4</i> Level 3 (5 – 6 marks) Learners show comprehension of information from the article to produce a full response containing most of the scientific points.	6	Indicative scientific points may include Soap <ul style="list-style-type: none"> • Soap formed by reaction of ricinoleic acid with NaOH • ionic head • (largely) non-polar tail

Question	Answer	Marks	Guidance
	<p><i>The explanation is relevant and logically structured and contains no errors.</i></p> <p>Level 2 (3 – 4 marks) Learners show some comprehension of information from the article to produce a partial response containing some of the scientific points</p> <p><i>The explanation is generally relevant and logically structured and contains few errors.</i></p> <p>Level 1 (1 – 2 marks) Learners show partial comprehension of information from the article to produce a response containing a few of the scientific points</p> <p><i>A partial explanation is attempted and has some structure.</i></p> <p>Level 0 (no marks) No response or no response worthy of credit.</p>		<ul style="list-style-type: none"> • structure (eg sodium ricinoleate) <p>Solubility</p> <ul style="list-style-type: none"> • PCMX low solubility in water because only the OH group can form hydrogen bonds • PCMX held in micelles/ description of micelles (by soap molecules) ALLOW 'held in pine oil droplets that are made soluble(AW) by soap molecules' as an alternative held by id-id bonds in micelles • ionic heads allow solubility in water/ forms hydrogen bonds with the water molecules • equilibrium with free PCMX in water • idea of reservoir
	Total	20	