Oxford Cambridge and RSA

GCE

Chemistry B

H433/02: Scientific literacy in chemistry

A Level

Mark Scheme for June 2024

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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.

PREPARATION FOR MARKING

RM ASSESSOR

1. Make sure that you have accessed and completed the relevant training packages for on-screen marking: *RM 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 available in RM Assessor.
3. Log-in to RM Assessor and mark the **required number** of practice responses (“scripts”) and the **required number** of standardisation responses.

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 RM Assessor 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 RM Assessor messaging system.

5. **Crossed Out Responses**
Where a candidate has crossed out a response and provided a clear alternative then the crossed out response is not marked. Where no alternative response has been provided, examiners may give candidates the benefit of the doubt and mark the crossed out response where legible.

Rubric Error Responses – Optional Questions
Where candidates have a choice of question across a whole paper or a whole section and have provided more answers than required, then all responses are marked and the highest mark allowable within the rubric is given. Enter a mark for each question answered into RM assessor, which will select the highest mark from those awarded. *(The underlying assumption is that the candidate has penalised themselves by attempting more questions than necessary in the time allowed.)*

Multiple Choice Question Responses
When a multiple choice question has only a single, correct response and a candidate provides two responses (even if one of these responses is correct), then no mark should be awarded (as it is not possible to determine which was the first response selected by the candidate).
When a question requires candidates to select more than one option/multiple options, then local marking arrangements need to ensure consistency of approach.

Contradictory Responses
When a candidate provides contradictory responses, then no mark should be awarded, even if one of the answers is correct.

Short Answer Questions (requiring only a list by way of a response, usually worth only **one mark per response**)
Where candidates are required to provide a set number of short answer responses then only the set number of responses should be marked. The response space should be marked from left to right on each line and then line by line until the required number of responses have been considered. The remaining responses should not then be marked. Examiners will have to apply judgement as to whether a 'second response' on a line is a development of the 'first response', rather than a separate, discrete response. *(The underlying assumption is that the candidate is attempting to hedge their bets and therefore getting undue benefit rather than engaging with the question and giving the most relevant/correct responses.)*

Short Answer Questions (requiring a more developed response, worth **two or more marks**)
If the candidates are required to provide a description of, say, three items or factors and four items or factors are provided, then mark on a similar basis – that is downwards (as it is unlikely in this situation that a candidate will provide more than one response in each section of the response space.)

Longer Answer Questions (requiring a developed response)
Where candidates have provided two (or more) responses to a medium or high tariff question which only required a single (developed) response and not crossed out the first response, then only the first response should be marked. Examiners will need to apply professional judgement as to whether the second (or a subsequent) response is a 'new start' or simply a poorly expressed continuation of the first response.

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 'SEEN' to confirm that the work has been seen.

7. Award No Response (NR) if:
   - there is nothing written in the answer space.

   Award Zero '0' if:
   - anything is written in the answer space and is not worthy of credit (this includes text and symbols).

   Team Leaders must confirm the correct use of the NR button with their markers before live marking commences and should check this when reviewing scripts.

8. The RM Assessor **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 RM Assessor 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, using the Level descriptors to help you decide whether it is a strong or weak answer. The indicative scientific content in the Guidance column 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 skills and science content evidenced within the answer, first decide which set of level descriptors, Level 1, Level 2 or Level 3, best describes the overall quality of the answer.

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 skills and science content determines the level.

The communication statement determines the mark within a level.

Level of response questions on this paper are **3b** and **5d**

The **only** annotation on a level of response question should be the **indication of the level.**
Please do not use ticks or highlight areas.

The appropriate level annotation should be used e.g. If a candidate has 6 marks, they would have the annotation  on their script.

If a candidate has achieved 5 marks then they have reached Level 3 but without the communication mark. They should have the following annotations on their script: 

The same principle should be applied to Level 2 and Level 1.

No marks (0) should have a cross.

Please place the annotations in the left-hand margin of the main answer space.

On additional pages, please annotate using 'SEEN'

11. Annotations available in RM Assessor

Annotation	Meaning
	Correct response
	Incorrect response
	Omission mark
BOD	Benefit of doubt given
CON	Contradiction
RE	Rounding error
SF	Error in number of significant figures
ECF	Error carried forward
L1	Level 1
L2	Level 2
L3	Level 3
NBOD	Benefit of doubt not given
SEEN	Noted but no credit given
I	Ignore

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

Annotation	Meaning
I	alternative and acceptable answers for the same marking point
✓	Separates marking points
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

13. **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:

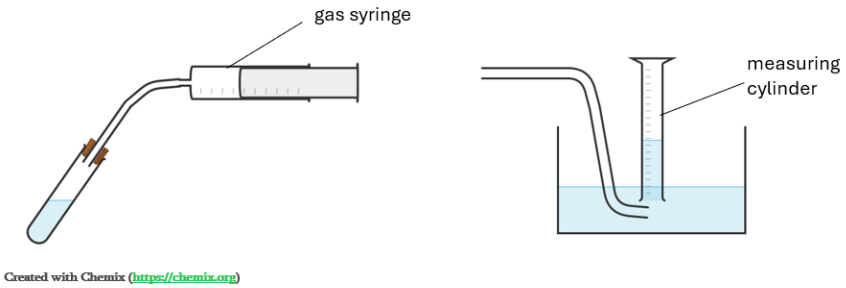
- the specification, especially the assessment objectives
- the question paper
- the mark scheme.

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**.

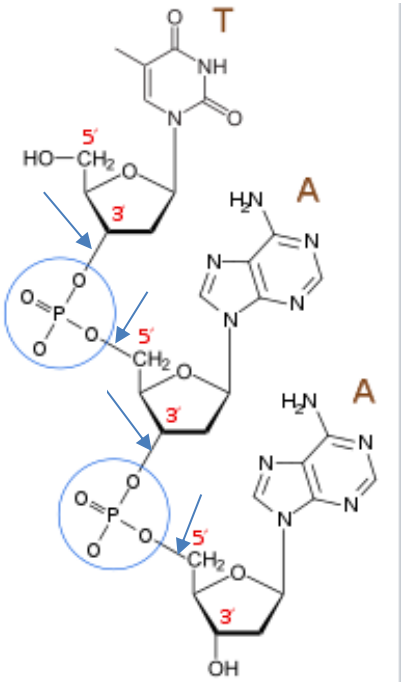
Please ask for help or guidance whenever you need it. Your first point of contact is your Team Leader.

Question			Answer	Mark	Guidance
1	a	i	saturated **C AND** trans unsaturated **A** ✓	1	
	a	ii	+3NaOH ✓ → $R'COO^-$ + $R''COO^-$ + $R'''COO^-$ + $3Na^+$ ✓ + $CH_2(OH)CH(OH)CH_2OH$ ✓	3	**ALLOW** R'COONa etc for second mark but **DO NOT ALLOW** R'COOH etc **ALLOW** any unambiguous formulae.
	b		RCOOH + CH_3OH ✓ → $RCOOCH_3$ + H_2O ✓	2	**ALLOW** any unambiguous formulae
	c	i	Nitrogen/N_2 ✓	1	**ALLOW** argon/Ar **IGNORE** other noble gases
		ii	high-boiling liquid ✓ porous (solid) support ✓	2	**ALLOW** non-volatile solvent
		iii	(relative) mol(ecul)ar mass/ M_r ✓	1	**ALLOW** M/z
	d		palmitate at 22±2 ✓ stearate at 27±2 ✓ linseed oil is **E** ✓ because ratio is 5:4 ✓	4	
	e	i	**FIRST CHECK ANSWER ON ANSWER LINE** **If answer in the range 88.8 - 90.1 (g), award 2 marks** (amount of oleic acid =) 100/282 (mol) /0.3546/0.355 (mol)✓ x 2 x 126.9 = 90 (g) ✓	2	**ALLOW** ECF from incorrect Mr of oleic acid
	e	ii	Only 1 hydroxyl group/molecule of water will add across the double bond ✓ substance formed: $CH_3(CH_2)_7CH(OH)(CH_2)_8COOH$. ✓	2	**ALLOW** $CH_3(CH_2)_8CH(OH)(CH_2)_7COOH$ **ALLOW** any unambiguous formula
				18	

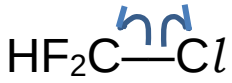
Question			Answer	Mark	Guidance
2	a	i	**FIRST CHECK ANSWER ON ANSWER LINE** **If answer = 86.8/86.9 (g), award 4 marks** mass = 0.305 g ✓ amount $MgCO_3$ = 0.305/84.3 = 3.62 x 10^{-3} (mol) ✓ vol CO_2 = 24000 x 3.62 x 10^{-3} = 86.832... (cm^3) ✓ 3 sf 86.8 ✓	4	If candidate uses $MgCO_3$ =84 **NOT** MP2 but allow ECF If use of pV = nRT answer in the range 88.8 – 89.6 to 3sf scores MP3 & 4 Last mark can be awarded for any calculated number to 3sf.
	a	ii	 Flask or test-tube, connected without leaks and with clear passage for gas✓ to either a labelled gas syringe or a labelled measuring cylinder over water ✓	2	Independent marking points
	b	i	Si: $(1s^2)2s^22p^63s^23p^2$ ✓ Mg^{2+}: $(1s^2)2s^22p^6$ ✓	2	
	b	ii	Si atoms are <u>smaller</u> ✓ more protons ✓ attract outer/valence electrons (in the same shell) more strongly ✓ more energy required to remove (an electron) ✓	4	**ALLOW ORA throughout** **ALLOW** atomic radius of Si is less than Mg **IGNORE** nucleus is bigger **IGNORE** 'shielding'

	c	**i**	**FIRST CHECK ANSWER ON ANSWER LINE** **If answer = 7 award 3 marks** Amount $FeSO_4$ = 3.1/151.9 = 0.020 ✓ Amount H_2O = 2.5/18 = 0.139✓ Ratio = 1:7, so x = 7 ✓	**3**	**ALLOW** ECF
	c	**ii**	Equation: $2FeSO_4 \rightarrow Fe_2O_3 + SO_2 + SO_3$ ✓ Iron product /brown solid is Fe_2O_3 ✓ acidic gases are SO_2 and SO_3 ✓	**3**	**ALLOW** iron product has Mr = 159.6
	d	**~~i~~**	bidentate ✓	**1**	**ALLOW** polydentate
	d	**ii**	(dative) covalent **OR** co-ordinate ✓	**1**	**ALLOW** dative on its own
		iii	square planar ✓	**1**	**ALLOW** tetrahedral
	e	**~~i~~**	**FIRST CHECK ANSWER ON ANSWER LINE** **If answer = 65.7(mg) award 4 marks** (Amount $KMnO_4$) = 25.5 x 0.00277/1000 (= 7.0635 x 10^{-5}) (mol) ✓ (Mass Fe) = 5 x 55.8 x 7.0635 x 10^{-5} (=0.0197(g)) in 25 cm^3 ✓ = 0.197 g in 250 cm^3 ✓ Per tablet 0.197 x 10^3/3 = 65.7 (mg) ✓	**4**	**ALLOW** 2 or more sf **ALLOW** ECF MP3 can be scored from a calculation where mass/moles Fe in 25cm^3 is multiplied by 10 AND evaluated
	e	**ii**	Manganate (VII) in burette ✓ End point – first permanent trace of pink colour (AW) ✓ Repeat until concordant ✓	**3**	**DO NOT ALLOW** use of indicators **ALLOW** solution turns pink at end point **ALLOW** titres within 0.2cm^3
				28	

Question			Answer	Mark	Guidance
3	a	i	$HOOC(CH_3)CHNHCOCH(CH_2OH)NH_2$ **OR** $HOOC(CH_2OH)CHNHCOCH(CH_3)NH_2$ peptide link ✓ complete structure ✓	2	**ALLOW** any unambiguous structure/zwitterion
	a	ii	secondary amide ✓	1	**ALLOW** $2^o/2^y$
	a	iii	Water/H_2O is formed ✓	1	
	b		Please refer to the marking instructions on page 5 of this mark scheme for guidance on how to mark this question. **Level 3 (5–6 marks)** Gives most main points and some fine detail for each area *There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.* **Level 2 (3–4 marks)** Gives most main points and some fine detail from one area **OR** Gives some main points from both areas *There is a line of reasoning presented with some structure. The information presented is relevant and supported by some evidence.* **Level 1 (1–2 marks)** Gives some main points from one area *There is an attempt at a logical structure with a line of reasoning. The information is in the most part relevant.* **0 marks** *No response or no response worthy of credit.*	6	**Indicative scientific points include:** *fine detail in italic* **Experimental detail AO1.2 (2) and AO 3.3 (1)** • spotting mixture and two aa's separately • *pencil line* • place in (suitable) solvent • *below line/spots* • *cover* • *remove and dry paper* • mark solvent front • use locating agent/ ninhydrin / uv lamp **Results AO3.4 (3)** ***can be on diagram*** • *starting line* • two spots from mixture and one each from aa • *solvent front marked* • aa spots at correct relative levels to mixture • Rf values roughly correct

	c	**i**	secondary ✓	**1**	**ALLOW** α-helix **ALLOW** $2^{o}/2^{y}$
	c	**ii**	hydrogen (bonds) ✓	**1**	**IGNORE** other imf's
	d	**i**	 any one arrow as shown ✓	**1**	Arrow must cleave DNA chain as shown to release a PO_4^{3-} ion, any additional arrow is CON if it cleaves any other group from the DNA chain
	d	**ii**	(Nitrogenous) base ✓	**1**	**ALLOW** nucleotide **DO NOT ALLOW** base pairs/pairings
	e	**i**	Active Site has complementary shape to DNA/substrate ✓ only specific shape/correct bases on DNA will bind/fit ✓	**2**	**ALLOW** Active Site is where DNA/substrate binds/fits
	e	**ii**	DNA codes for amino acids ✓ Incorrect coding/ mutation would produce wrong protein/enzymes/genetic information/ORA ✓	**2**	
				18	

Question			Answer	Mark	Guidance
4	a	i	$[H^+]\ [CH_3COO^-]/[CH_3COOH]$ ✓	1	
	a	ii	**FIRST CHECK ANSWER ON ANSWER LINE** **If answer = 2.8, award 2 marks** $[H^+] = \sqrt{(1.7 \times 10^{-5} \times 0.15)} = 1.59 \times 10^{-3}$ ✓ pH = 2.8 ✓	2	**ALLOW** more places (2.799/ 2.80) **ALLOW** ecf for second mark from $10^{-5} < [H^+] < 10^{-2}$
	a	iii	Strong acid should have a lower pH ✓ Stronger acid would produce greater $[H^+]$ (as it dissociates more into it ions) ✓	2	
	b		Student 2 because $NaOH/OH^-$ removes H^+ ✓ equilibrium (position) moves to right (until all CH_3COOH used up) ✓	2	**IGNORE** choice of student, marks are for the explanation
	c		**FIRST CHECK ANSWER ON ANSWER LINE** **If answer = 8.8, award 3 marks** $(OH^-) = \sqrt{(0.075 \times 1 \times 10^{-14}/1.7 \times 10^{-5})} = 6.64 \times 10^{-6}$ (mol dm^{-3}) ✓ $(H^+) = 1 \times 10^{-14}/6.64 \times 10^{-6} = 1.5 \times 10^{-9}$ (mol dm^{-3}) ✓ pH = 8.8 ✓	3	**ALLOW** more places (8.822) **ALLOW** ECF Can be awarded from any expression "$[H^+] = \ldots$"
	d	i	**FIRST CHECK ANSWER ON ANSWER LINE** **If answer = 3.4×10^{-5}, award 2 marks** $[H^+] = K_a \times [CH_3COOH]/[CH_3COO^-]$ ✓ $= K_a \times 2 = 3.4 \times 10^{-5}$ (mol dm^{-3}) ✓	2	**ALLOW** $[H^+] = K_a \times (0.15)/(0.15) = 1.7 \times 10^{-5} / K_a/2 = 8.5 \times 10^{-6}$ for 1 mark
	d	ii	Equilibrium moves to left/reactant (removing H^+) ✓ $[H^+]$ remains (virtually) constant because $[CH_3COOH]$ and $[CH_3COO^-]$ are (relatively) large ✓	2	**ALLOW** 'moves backwards' / additional H^+ reacts with CH_3COO^-
				14	

Question			Answer	Mark	Guidance
5	a	i	 ✓	1	
	a	ii	homolytic (fission) **AND** electrons go back to their original atoms/ one electron to each atom / forms TWO radicals ✓	1	**IGNORE** 'molecules;
5	a	iii	$O_3 + Cl \rightarrow O_2 + ClO$ ✓ $ClO + O \rightarrow Cl + O_2$ ✓	2	**ALLOW** $ClO + O_3 \rightarrow Cl + 2O_2$
5	a	iv	**FIRST CHECK ANSWER ON ANSWER LINE** **If answer is 1.3 x 10^5 award 3 marks** (amount Cl) = 1/86.5 mol = 1.16 x 10^{-2} (mol) ✓ (amount O_3) = 70000/48 = 1458 (mol); ✓ no. of ozone molecules = 1.3 x 10^5 (to 1 dp) ✓	3	**ALLOW** ECF **IGNORE** use of the Avogadro constant twice To score third mark, answer must be a correct evaluation of their ratio to 1 dp and in standard form
	b	i	 ✓	1	**ALLOW** any angles for H-O-O-H **ALLOW** all dots/all crosses for electrons
5	b	ii	Four electron pairs/ areas of electron density/ two lone pairs and two bonding pairs (around O) ✓ Lone pairs repel more/take up more room (AW) ✓ Bond angle = 104.5^0✓	3	**ALLOW** tetrahedral angle is 109.5^o
5	b	iii	$H_2O_2 + 2e^- + 2H^+ \rightarrow 2H_2O$ ✓ $H_2O_2 \rightarrow O_2 + 2H^+ + 2e^-$ ✓ Reducing agent supplying electrons and oxidising agent removing electrons ✓	3	**ALLOW** any correctly balanced equations using species present in the ANA Correct equations in wrong order score 2 marks Wrong equations with electrons on correct sides (ie right for reducing agent and left for oxidising agent) score 1 mark
5	c		-1 ✓ -½ ✓	2	

5	**d**		Please refer to the marking instructions on page 5 of this mark scheme for guidance on how to mark this question. **Level 3 (5–6 marks)** Makes most main points for all three ROS (reactive oxygen species) with some fine detail points overall. *There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.* **Level 2 (3–4 marks)** Makes most of the main points from two ROS **OR** Makes some of the main points from all three ROS *There is a line of reasoning presented with some structure. The information presented is relevant and supported by some evidence.* **Level 1 (1–2 marks)** Makes some of the main points from one or two ROS. *There is an attempt at a logical structure with a line of reasoning. The information is in the most part relevant.* **0 marks** *No response or no response worthy of credit.*	**6**	***Indicative Scientific points include** (fine detail in italic)* **hydroxyl** • very reactive • *react at rate of diffusion* • remove electrons from biological(AW) molecule • eg *protein, lipid, DNA* • example: DNA damage (mutations, cancer) **or** lipid peroxidation • *presence or absence of iron does not matter* **hydrogen peroxide** • forms hydroxyl with Fe^{2+} (Fenton reaction) • equation ` $H_2O_2 + Fe^{2+} \rightarrow OH^- + OH + Fe^{3+}$ • slow diffusion into cell • *thus dangerous as forms hydroxyl there* **superoxide** • *not reactive in itself* • returns Fe^{3+} to Fe^{2+} • equation • continues Fenton reaction in presence of iron.
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