OCR
Oxford Cambridge and RSA

Higher

GCSE

Chemisty B Twenty First Century Science

J258/03: Breadth in Chemistry (Higher Tier)

General Certificate of Secondary Education

Mark Scheme for June 2024

OCR (Oxford Cambridge and RSA) is a leading UK awarding body, providing a wide range of qualifications to meet the needs of candidates of all ages and abilities. OCR qualifications include AS/A Levels, Diplomas, GCSEs, Cambridge Nationals, Cambridge Technicals, Functional Skills, Key Skills, Entry Level qualifications, NVQs and vocational qualifications in areas such as IT, business, languages, teaching/training, administration and secretarial skills.

It is also responsible for developing new specifications to meet national requirements and the needs of students and teachers. OCR is a not-for-profit organisation; any surplus made is invested back into the establishment to help towards the development of qualifications and support, which keep pace with the changing needs of today's society.

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.

MARKING INSTRUCTIONS

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. 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 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.

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
/	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.

The breakdown of Assessment Objectives for GCSE (9-1) in Chemistry B:

	Assessment Objective
AO1	**Demonstrate knowledge and understanding of scientific ideas and scientific techniques and procedures.**
AO1.1	Demonstrate knowledge and understanding of scientific ideas.
AO1.2	Demonstrate knowledge and understanding of scientific techniques and procedures.
AO2	**Apply knowledge and understanding of scientific ideas and scientific enquiry, techniques and procedures.**
AO2.1	Apply knowledge and understanding of scientific ideas.
AO2.2	Apply knowledge and understanding of scientific enquiry, techniques and procedures.
AO3	**Analyse information and ideas to interpret and evaluate, make judgements and draw conclusions and develop and improve experimental procedures.**
AO3.1	Analyse information and ideas to interpret and evaluate.
AO3.1a	Analyse information and ideas to interpret.
AO3.1b	Analyse information and ideas to evaluate.
AO3.2	Analyse information and ideas to make judgements and draw conclusions.
AO3.2a	Analyse information and ideas to make judgements.
AO3.2b	Analyse information and ideas to draw conclusions.
AO3.3	Analyse information and ideas to develop and improve experimental procedures.
AO3.3a	Analyse information and ideas to develop experimental procedures.
AO3.3b	Analyse information and ideas to improve experimental procedures.

Question			Answer	Marks	AO element	Guidance
1	(a)		Phosphorus / P✓ Potassium / K ✓	2	1.1	**IGNORE** other elements
	(b)	(i)	enters watercourses / eutrophication / increased algal growth/weed/plant growth in watercourses / kills fish/marine or river life / leads to oxygen depletion in water ✓	1	1.1	**IGNORE** bioaccumulation **IGNORE** more weeds unqualified **IGNORE** death of plants/animals/less biodiversity/poor soil fertility
		(ii)	There are not enough natural fertilisers / synthetic fertilisers can be manufactured in large quantities / need to grow more food/crops / lead to faster growth / more yield ✓	1	3.2a	**IGNORE** more plants alone **IGNORE** references to pesticides **IGNORE** 'cheaper' or cost arguments alone / easier to use / grow better / readily available **ALLOW** helps plants to grow **ALLOW** implied comparison e.g. high growth/fast growth **ALLOW** acts faster / described disadvantage of natural fertiliser e.g. smell / quantity needed

	(c)		**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 81.6(%) award 4 marks** (mass of atoms in desired product) = 80.0 ✓ (total mass of atoms in reactants) = 35.0 + 63.0 (only) OR 98.0 ✓ atom economy = 80.0/98.0 x 100 OR = 81.6326…(%) ✓ 81.6 (%) ✓	**4**	**3 x 2.2** **1.2**	**Answer other than 81.6 is max 3** **ALLOW** 80 if shown as numerator in calculation (even if added to another number) **ALLOW MP2** anywhere (even if shown as numerator) **ALLOW** 35+63 (only) seen anywhere in calculation **DO NOT ALLOW** other numbers added to 35 + 63 **MP3** Must be correct substitution 80/98 x100 81.6326….. = 3 marks **MP4 ALLOW** incorrect answer, with working to 1dp

Question			Answer	Marks	AO element	Guidance
2	(a)	(i)	**Any 2 from:** electrostatic forces ✓ between oppositely charged ions / between positive ions and negative ions ✓ sodium ions are positively charged and chloride ions are negatively charged ✓	2	1.1	**IGNORE** attractive forces / static forces **ALLOW** electrostatic attraction **MAX 1** if single bonds /covalent bonds / imfs / delocalised electrons / protons and electrons are stated **ALLOW** cation = positive ion and anion = negative ion throughout **IGNORE** 'chlorine' ions **IGNORE** between sodium ions and chloride ions **ALLOW** 2 marks for 'attractive forces between positive sodium ions and negative chloride ions'
		(ii)	Model C does not show the 3-D arrangement of ions ✓ Only one model shows that chlorine is an anion ✓	2	3.1a	
		(iii)	electron arrangement of 2.8.8 drawn ✓ -1 / 1- / - ✓	2	2.2	**ALLOW** different symbols for electrons / all the same electron symbol
	(b)		Number of electron shells is the same as period number / sodium or chlorine has three shells and is in period 3 ✓ Number of electrons in outer shell is the same as the group number / sodium is in group 1 and has 1 electron in the outer shell / chlorine is in Group 7 and has 7 electrons in the outer shell ✓	2	2.1	**ALLOW** shows/determines for 'is the same' as long as 'number' or 'how many' is stated somewhere in the answer. **DO NOT ALLOW** sodium has two shells and is in period 2 **IGNORE** references to losing/gaining electrons **DO NOT ALLOW** if statement for chlorine or sodium is incorrect
	(c)		Protons = 11 ✓ Neutrons = 12 ✓ Electrons = 11 ✓	2	2.2	3 correct = 2 marks 2 or 1 correct = 1 mark

3	(a)		Dyes are soluble/dissolve in hexane / dyes are insoluble in water / do not dissolve in water ✓	1	1.2	**IGNORE** to separate the spots/dyes / so that the dyes/spots move / otherwise spots/dyes don't move
	(b)		**FIRST CHECK THE ANSWER ON THE ANSWER LINE** **If answer = 0.58 award 4 marks** 3.5 ✓ 6(.0) ✓ R*f*= spot distance / solvent distance OR 3.5/6.0 (= 0.58333…) ✓ R*f*= 0.58(3) ✓	4	2.2	**ALLOW** 3.5 +/-0.1 **ALLOW** answers in mm e.g. 35mm **ALLOW** 6.0+/-0.1 (cm) **ALLOW** ECF on incorrect measurements for MP3 and MP4 **ALLOW** MP4 for incorrect answer with working to 2 or 3 sf
	(c)		Locating agent ✓	1	1.1	**ALLOW** named locating agent e.g. ninhydrin / iodine **IGNORE** UV light

Question			Answer	Marks	AO element	Guidance
4	(a)		A contains chloride (ions) / Cl^- (ions) ✓ B contains no halide (ions) ✓ C contains iodide (ions) / I^- (ions) ✓	3	3.2b	**DO NOT ALLOW** contains chlorine ions / iodine ions **ALLOW** no chloride <u>and</u> no bromide <u>and</u> no iodide ions present
	(b)		Silver bromide ✓ AgBr ✓ aq and aq ✓	3	1.1 1.1 2.1	**DO NOT ALLOW** silver bromine **DO NOT ALLOW** 'silver bromide ions' **DO NOT ALLOW** numbers added such that equation does not balance **IGNORE** Ag^+Br^-
	(c)		Contains chloride (ions)/Cl^- (ions) / gives (white) precipitate/positive result (with silver nitrate/silver ions) ✓	1	2.1	**IGNORE** it will react with silver nitrate **DO NOT ALLOW** contains chlorine

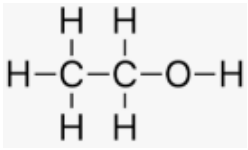
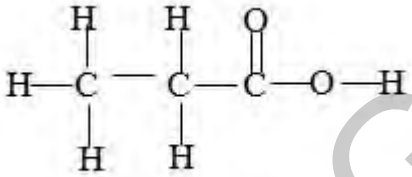
Question			Answer	Marks	AO element	Guidance
5	(a)	(i)	$4OH^- \rightarrow O_2 + 2H_2O + 4e$ All formulae and electrons shown ✓ Correct numbers used in balancing. ✓	2	2.2	**ALLOW** multiples e.g. $2OH^- \rightarrow ½ O_2 + H_2O + 2e$ **ALLOW** '- (4)e' on the LHS **ALLOW** $4OH^- - 4e \rightarrow O_2 + 2H_2O$
		(ii)	copper ions gain electrons / (reduction is) gain of electrons/ ✓	1	1.1	**IGNORE** numbers of electrons if stated
		(iii)	Copper less reactive than hydrogen/lower in reactivity series than hydrogen ✓ Copper ions gain electrons more easily (than hydrogen ions) / copper ions reduced more easily ✓	2	2.1	
		(iv)	**Any one from** Bubbles seen (at the anode)✓ Pink solid (on cathode/electrode) ✓ (Blue) colour of solution fades/goes colourless ✓	1	1.2	Electrodes do not need to be stated but if stated must be correct. **IGNORE** names of gases **ALLOW** brown / red-brown / orange / black solid **ALLOW** pink solid alone but **DO NOT ALLOW** pink solid on anode **IGNORE** cathode increases in size/layer forms **IGNORE** clear
	(b)	(i)	$2Al_2O_3 \rightarrow 4Al$ ✓ + $3O_2$✓	2	2.2	**ALLOW** multiples **For 1 mark** **ALLOW** for same number of Al atoms on both sides / same number of O atoms on both sides
		(ii)	A high temperature is needed for the process. ✓ Electrolysis uses a large amount of energy. ✓	2	1.1	
		(iii)	Glowing splint ✓ Flame will re-ignite if oxygen is present ✓	2	1.2	**DO NOT ALLOW** lighted splint (=0) **ALLOW** lighted splint blown out **ALLOW MP2** only for 'glowing lit splint relights'

Question			Answer	Marks	AO element	Guidance
6	(a)	(i)	$CaCl_2$ ✓	1	1.1	
		(ii)	carbon dioxide is made / a gas is made ✓ (the gas) escapes/is given off/is lost/is released/leaves the conical flask ✓	2	1.1	**MAX 1 mark** for indication that mass change relates to other reason e.g. heat given out /calcium carbonate dissolves / solution evaporates / steam given off **IGNORE** the mass is lost / the mass decreases
	(b)	(i)	**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 0.1369 award 3 marks** M_r = (35.5 + 1) OR 36.5 ✓ number of moles = 5.0/36.5 ✓ 0.14 / 0.137 ✓	3	2.2	 **ALLOW** (35.5 + 1) OR 36.5 anywhere in answer **ALLOW** ECF on incorrect RFM for MP2 only **ALLOW** 2 or more sig figs (0.1369863…) **ALLOW** answer to more than 2 sig figs if answer rounds to 0.14
		(ii)	4.8×10^{24} ✓	1	1.2	

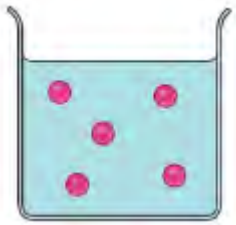
Question			Answer	Marks	AO element	Guidance
7	(a)		It lowers the activation energy of the reaction ✓	1	1.1	
	(b)		Particles closer together / more particles per unit volume ✓ Particles collide more frequently / more collisions per unit time/per second ✓	2	1.2	**DO NOT ALLOW MP1** if answer states that particles have more energy/move faster **IGNORE** more successful/effective collisions **IGNORE** 'more collisions' alone
	(c)		**FIRST CHECK THE ANSWER ON THE ANSWER LINE** **If answer = 2400(cm^3) award 3 marks** (Rearrange): Volume of gas = no. of moles x 24 ✓ (Substitute): Volume of gas = 0.1 x 24 OR = 2.4(dm^3) ✓ 2400 (cm^3) ✓	3 2 x 2.2 1.2		**Max 2 marks if** final answer is not = 2.4 x 10^x Note: 2.4 x 10^{-3} is probably MP1 and MP2 with incorrect unit conversion (= 2) **ALLOW** 0.1 x 24 as evidence of **MP1 and MP2** **MP2 ALLOW** substitution into unrearranged formula i.e. 0.1 = volume of gas/24 **ALLOW** 2 marks for 2.4 (MP1 and MP2) **ALLOW** MP3 for x 1000 (correct conversion dm^3 to cm^3)

Question			Answer	Marks	AO element	Guidance
8	(a)	(i)	Methane ✓	1	1.1	
		(ii)	Exothermic ✓	1	1.1	
		(iii)	Carbon monoxide / (carbon) particulates ✓	1	1.1	**DO NOT ALLOW** carbon dioxide **IGNORE** methane / unburnt hydrocarbons / soot
	(b)		**FIRST CHECK THE ANSWER ON THE ANSWER LINE** **If answer = -490(kJ) award 3 marks** (2 x 434 kJ) + 498 kJ = 1366 kJ ✓ 4 x 464 kJ = 1856 kJ ✓ 1366 kJ − 1856 kJ = −490 kJ ✓	3	2.2	**MP3 ALLOW** ECF on (MP1 - MP2) **IGNORE** 490, answer must show negative sign If ECF value is positive, answer does not need positive sign.
	(c)	(i)	Carbon dioxide **AND** water ✓	1	1.2	**DO NOT ALLOW** carbon monoxide/carbon particulates **ALLOW** CO_2 and H_2O Names take precedence
		(ii)	(production) Hydrogen or water is renewable /diesel/crude oil is not renewable / is a fossil fuel / is finite ✓ (use) (Combustion of) hydrogen produces no carbon dioxide / hydrogen produces <u>only</u> water ORA ✓	2	3.1b	**ALLOW MP1** for producing hydrogen or diesel uses energy / uses energy from fossil fuels **ALLOW** (combustion of) hydrogen does not cause global warming/climate change/produce greenhouse gases / NOx/SO_2/CO/C particulates/cause acid rain ORA **ALLOW** 'carbon dioxide causes global warming/climate change/is a greenhouse gas' alone (link to diesel is in ci) **IGNORE** diesel produces carbon dioxide alone **IGNORE** references to fuel cells

		(iii)	Diesel is a liquid <u>and</u> hydrogen is a gas ✓ boiling point of diesel is above room temperature / boiling point of hydrogen is below room temperature ✓	2	3.2b	**IGNORE** references to bonds and imfs **IGNORE** references to simple covalent / simple molecular structures **IGNORE** hydrogen has a lower molecular mass

Question			Answer	Marks	AO element	Guidance
9	(a)		Methanol; ✓  ✓	2	1.1	**ALLOW** -OH **DO NOT ALLOW** -HO
	(b)	(i)	Propanoic (acid) ✓	1	1.2	
		(ii)	 ✓	1	1.2	**DO NOT ALLOW** -OH

Question			Answer	Marks	AO element	Guidance
10	(a)		**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 233 award 4 marks**	4		**ALLOW** answers based on A_r Ag = 107.9 throughout
			MP1 Ag_2O RFM = 232 or 2xRFM = 464 ✓		1.2	**ALLOW** (2 x 108) +16 **ALLOW** RFM Ag_2O = 231.8 **ALLOW ECF** on incorrect RFM in rest of calculation
			MP2 shows 250/232 OR 250/464 ✓		2 x 2.2	
			MP3 shows 250/232 x (2x108) **OR** 250/464 x (4x108) (= 232.7586…..) ✓			Note (2x108) =216 and (4x108) =432
			MP4 = 233 ✓		1.2	**MP4 ALLOW** incorrect answer with working to 3sf
			OR ALTERNATIVE ROUTE MP1 Ag_2O RFM = 232 or 2xRFM = 464✓		1.2	**ALLOW** (2 x 108) +16 **ALLOW** RFM Ag_2O = 231.8
			MP2 shows 432/464 OR 216/232 (=0.931) ✓		2 x 2.2	**ALLOW ECF** on incorrect RFM in rest of calculation
			MP3 shows MP2 x 250 (= 232.7586…..) ✓			
			MP4 = 233 ✓		1.2	**MP4 ALLOW** incorrect answer with working to 3sf
	(b)		Increase the temperature of reaction ✓ Heat for a longer time ✓	2	3.3b	**IGNORE** add a catalyst / increase the heat / use more silver oxide / insulate **ALLOW** heat to constant mass

Question			Answer	Marks	AO element	Guidance
11	(a)		 ✓	1	1.1	Judge number by eye **ALLOW** particles similar size or smaller **IGNORE** shading/no shading Particles must be single, randomly arranged
	(b)	(i)	Strength of acid depends on degree of ionisation/strong acids fully ionise/are more fully ionised ORA ✓	1	1.1	**ALLOW** 'how well ionised/ better ionised' etc for degree of ionisation **ALLOW** dissociated for ionised **IGNORE** 'ionised' alone unqualified **IGNORE** references to pH **IGNORE** references to hydrogen ion concentration alone
		(ii)	Acid C ✓ Highest pH/ slowest reaction/longest time to react / pH closest to 7/neutral ✓ so lower <u>concentration</u> of hydrogen ions ✓	3	3.2b	 **IGNORE** 'it is pH5' unqualified **IGNORE** fewer/less hydrogen ions
	(c)	(i)	(Add a few drops and) <u>colour</u> judged against a chart/pH scale ✓	1	1.2	
		(ii)	1.0×10^{-3} $moldm^{-3}$ ✓	1	1.2	

Question			Answer	Marks	AO element	Guidance
12	(a)		Gas ✓ Red ✓	2	1.1	**ALLOW** brick red / red-brown / orange-red / orange / orange-brown **IGNORE** brown alone
	(b)	(i)	Brown solution formed ✓ Chlorine displaces iodine / displacement reaction ✓ Chlorine is more reactive (than iodine) / reactivity decreases down the group ✓	3	1.2	**ALLOW** grey or black solid/precipitate formed **ALLOW** red-brown / yellow-brown / orange-brown / yellow **DO NOT ALLOW** orange alone **DO NOT ALLOW** chloride is more reactive / chlorine is more reactive than iodide
		(ii)	$Cl_2 + 2I^- \rightarrow 2Cl^- + I_2$ ✓	1	2.1	**IGNORE** state symbols

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