

Higher

GCSE

Chemistry B Twenty First Century Science

J258/03: Breadth in Chemistry (Higher Tier)

General Certificate of Secondary Education

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.

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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:
- where a candidate crosses out an answer and provides an alternative response, the crossed out response is not marked and gains no marks
 - 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
	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

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
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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) ✓ Rf= spot distance / solvent distance OR 3.5/6.0 (= 0.58333...) ✓ Rf= 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)	$4\text{OH}^- \rightarrow \text{O}_2 + 2\text{H}_2\text{O} + 4\text{e}^-$ All formulae and electrons shown ✓ Correct numbers used in balancing. ✓	2	2.2	ALLOW multiples e.g. $2\text{OH}^- \rightarrow \frac{1}{2}\text{O}_2 + \text{H}_2\text{O} + 2\text{e}^-$ ALLOW '- (4)e' on the LHS ALLOW $4\text{OH}^- - 4\text{e}^- \rightarrow \text{O}_2 + 2\text{H}_2\text{O}$
		(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)	$2\text{Al}_2\text{O}_3 \rightarrow 4\text{Al} + 3\text{O}_2$ ✓	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 <u>only</u> 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 x 10 ²⁴ ✓	1	1.2	

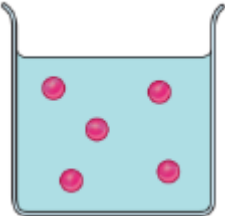
Question			Answer	Marks	AO element	Guidance
7	(a)		It lowers the activation energy of the reaction ✓	1	1.1	
	(b)		Particles closer together / more particles per unit volume ✓ Particles collide more frequently / more collisions per unit time/per second ✓	2	1.2	DO NOT ALLOW MP1 if answer states that particles 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(cm³) award 3 marks (Rearrange): Volume of gas = no. of moles x 24 ✓ (Substitute): Volume of gas = 0.1 x 24 OR = 2.4(dm³) ✓ 2400 (cm³) ✓	3	2 x 2.2 1.2	Max 2 marks if final answer is not = <u>2.4</u> 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 dm³ to cm³)

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 ₂ O 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 / NO _x /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
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Question			Answer	Marks	AO element	Guidance
9	(a)		Methanol; ✓ $\begin{array}{c} \text{H} \quad \text{H} \\ \quad \\ \text{H}-\text{C}-\text{C}-\text{O}-\text{H} \\ \quad \\ \text{H} \quad \text{H} \end{array}$	2	1.1	ALLOW -OH DO NOT ALLOW -HO
	(b)	(i)	Propanoic (acid) ✓	1	1.2	
		(ii)	$\begin{array}{c} \text{H} \quad \text{H} \quad \text{O} \\ \quad \quad // \\ \text{H}-\text{C}-\text{C}-\text{C}-\text{O}-\text{H} \\ \quad \\ \text{H} \quad \text{H} \end{array}$	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 MP1 Ag₂O RFM = 232 or 2xRFM = 464 ✓ MP2 shows 250/232 OR 250/464 ✓ MP3 shows 250/232 x (2x108) OR 250/464 x (4x108) (= 232.7586.....) ✓ MP4 = 233 ✓ OR ALTERNATIVE ROUTE MP1 Ag₂O RFM = 232 or 2xRFM = 464 ✓ MP2 shows 432/464 OR 216/232 (=0.931) ✓ MP3 shows MP2 x 250 (= 232.7586.....) ✓ MP4 = 233 ✓	4	1.2 2 x 2.2 1.2 1.2 2 x 2.2 1.2	ALLOW answers based on $A_r \text{ Ag} = 107.9$ throughout ALLOW (2 x 108) +16 ALLOW RFM Ag₂O = 231.8 ALLOW ECF on incorrect RFM in rest of calculation Note (2x108) =216 and (4x108) =432 MP4 ALLOW incorrect answer with working to 3sf ALLOW (2 x 108) +16 ALLOW RFM Ag₂O = 231.8 ALLOW ECF on incorrect RFM in rest of calculation 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)	$1.0 \times 10^{-3} \text{ mol dm}^{-3}$ ✓	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 <u>grey or black</u> 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)	$\text{Cl}_2 + 2\text{I}^- \rightarrow 2\text{Cl}^- + \text{I}_2$ ✓	1	2.1	IGNORE state symbols

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