

Foundation

GCSE

Chemistry A Gateway Science

J248/03: Paper 3 (Higher Tier)

General Certificate of Secondary Education

Mark Scheme for June 2023

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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:
 - 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 the annotation SEEN to confirm that the work has been read.
- 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.

Level of response question on this paper is 19(a).

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
LI	Level 1
L2	Level 2
L3	Level 3
NBOD	Benefit of doubt not given
SEEN	Noted but no credit given
I	Ignore

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

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.

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

	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.

For answers to Section A if an answer box is blank ALLOW correct indication of answer e.g. circled or underlined.

Question	Answer	Marks	AO element	Guidance
1	D	1	1.1	
2	В	1	1.2	
3	D	1	2.1	
4	С	1	1.1	
5	В	1	1.2	
6	Α	1	2.2	
7	С	1	2.2	
8	D	1	2.1	
9	С	1	1.2	
10	В	1	1.2	
11	D	1	1.1	
12	С	1	2.1	
13	A	1	1.1	
14	С	1	2.2	
15	D	1	2.2	

Q	uesti	on	Answer	Marks	AO element	Guidance
16	(a)		A reaction between an acid and an alkali is neutralisation. Acids form OH ⁻ ions in solution. Alkalis have a pH of less than 7. Sodium hydroxide, NaOH, is an example of an acid.	1	1.1	
	(b)	(i)	First check the answer on answer line If answer = 4.35 award 3 marks 4.37 + 4.31 + 4.38 or 13.06 ✓ 13.06 ÷ 3 = 4.3533 ✓ 3 significant figures: = 4.35 ✓	3	1.2 1.2 2.1	DO NOT ALLOW 4.37 + 4.38 only ALLOW ECF from incorrect total mass ALLOW ECF for significant figure mark
		(ii)	H ₂ O (I) CO ₂ (g) Correct formulae ✓ State symbols ✓	2	2.1 1.1	ALLOW H ₂ O (I) or CO ₂ (g) for 1 mark if both species and state symbols not correct Mark for state symbol dependent on correct species ALLOW filter
		(iv)	Crystallisation ✓	1	1.2	DO NOT ALLOW sieving ALLOW evaporation ALLOW heat it (so the solvent evaporates) IGNORE (simple) distillation

Q	uesti	on	Answer	Marks	AO element	Guidance
17	(a)	(i)	Clamp stand Thermometer Beaker	3	3 x 1.2	ALLOW retort stand / stand IGNORE just clamp
		(ii)	Any one from: Use a polystyrene cup (instead of a beaker) / put a lid / covering on the beaker (to keep heat in) / insulate the (outside of the) beaker / Use a digital thermometer / data logger (to measure the temperature) ✓	1	3.3b	IGNORE seal the beaker ALLOW idea of clamping or holding the thermometer in the middle of the solution / don't let thermometer touch the beaker ALLOW stir the solution

Q	Question		Answer			Marks	AO element	Guidance
	(b)	(i)	Linear scale on both axes ✓	Volume of acid (cm ³)	Temperature (°C)	2	2 x 2.2	x-axis must begin from 0
			Points plotted correctly ✓	0	18			ALLOW ±1/2 small square
				5	20			ALLOW bar chart or histogram
				10	23			MP2 is dependent on MP1
				15	26			
				20	27			IGNORE any line of best fit
				30	24			
				30	24			
		(ii)	(ii) (As the acid is added) the temperature increases ✓ Idea that after 20 cm³ (of acid is added) / after the reaction is complete, the temperature decreases ✓		2	2 x 3.1a		
		(iii)	The temperature increases ✓			1	2.1	ALLOW the reaction gets hotter IGNORE idea that energy / heat is released
	(c)		Idea of the (minimum) amount of reaction to start or occur ✓	of energy nee	eded for a	1	1.1	ALLOW idea of the (minimum) amount of energy for a successful collision (to occur)

G	Question	Answer	Marks	AO element	Guidance
18	(a)	Alpha / positively charged particles were fired at gold leaf ✓ Idea that most particles went (straight) through ✓ Idea that some particles were repelled by the (positive charge of the) nucleus ✓	3	3 x 1.1	IGNORE electrons for MP1 ALLOW some particles went (straight) through ALLOW idea that particles were deflected or reflected DO NOT ALLOW idea that most particles were repelled
	(b)	A proton has a positive charge and a relative mass of 1. An atomic radius is approximately 1 × 10 ⁻¹² m. An electron has a negative charge and a relative mass of 1. Most of the mass of the atom is in the nucleus. The radius of an atom is much smaller than the radius of a nucleus.	2	2 x 1.1	
	(c)	Two shared pairs of electrons between C and each O ✓ Rest of structure correct ✓	2	2 x 2.2	ALLOW electrons as all dots, all crosses, or a mix of dots and crosses ALLOW diagrams with inner electron shells, but inner shells must be correct if shown Second marking point is dependent on two shared pairs of electrons between C and each O

Q	uesti	on	Answer	Marks	AO element	Guidance
	(d)	(i)	Any three from:	3	3 x 1.1	Answers must be comparative
			Particles move faster in gas / move slower in solid ✓ Particles have more energy in gas / less energy in solid ✓ Particles are further apart in gas / closer together in solid ✓ Particles are arranged more randomly in gas / arranged regularly in solid ✓ Forces between particles are weaker in gas / stronger in solid ✓			ALLOW atoms / molecules for particles ALLOW idea of particles (vibrating) in a fixed position for regular arrangement in a solid
		(ii)	Temperature and pressure: 1.0 MPa and a temperature value between -55 and -41 °C✓ Reason: Idea that the temperature selected is between the melting and boiling point (so will be a liquid) / Idea that lower than -56°C CO₂ is a solid and above -40°C CO₂ is a gas ✓	3	3 x 3.2b	MP dependent on correct temperature
			 1.0 MPa has a melting and boiling point (whereas 0.1 MPa does not) / 1.0 MPa does not have a sublimation point ✓ 			ALLOW ORA for 0.1MPa ALLOW idea that 1.0 MPa is the pressure when CO ₂ can be a liquid (between -55 and -41 °C)

Question	Answer		AO element	Guidance
19 (a)*	Please refer to the marking instructions on page 4 of this mark scheme for guidance on how to mark this question. Level 3 (5–6 marks) Accurately applies knowledge and a detailed understanding to explain the product made at the electrode in each experiment AND Determines that the scientist should use experiment 2 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) Clearly, but with some limitations, applies knowledge and understanding to explain the product made at the electrode in each experiment AND Determines that the scientist should use experiment 2 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) Attempts to apply knowledge and understanding to explain the product made at the electrode in one of the experiments	6	4 x 2.2 2 x 3.2b	 AO3.2b Applies knowledge and understanding of electrolysis In experiment 1, molten copper chloride contains only Cu²+ ions and Ct ions In experiment 2, copper sulfate solution contains Cu²+, SO₄²-, H+ and OH+ ions Positive metal / hydrogen ions are attracted to the negative cathode Negative non-metal ions and are attracted to the positive anode Cu²+ ions are less reactive than H+ ions Cu²+ ions are discharged in preference to H+ ions AO3.2b Analyses information and ideas to draw conclusions Experiment 1 forms chlorine at the anode Experiment 2 forms copper at the cathode Experiment 2 forms oxygen at the anode Experiment 2 should be used Experiment 2 should be used

Questi	n Answer	Marks	AO element	Guidance	
	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.				
(b)	Electrodes should be in the lead bromide / electrolyte 🗸	2	2 x 3.3b	IGNORE use inert electrodes IGNORE connect the wire together	
	Lead bromide should be molten / the lead bromide should be heated (until it is molten) ✓			IGNORE lead bromide should be in aqueous solution	
(c)	2Br - 2e → Br ₂	2	2 x 1.2		
	Correct species ✓ Balancing ✓			Second MP is dependent on the first	

Q	uestion	Answer	Marks	AO element	Guidance
20	(a)	Idea of using filtration to separate the sand from the water and dissolved salt \(\) Idea of using distillation to collect the water from the salt solution \(\) Idea that the salt is left in the flask (after removal of the water by distillation) \(\) Correct choice of apparatus for at least one of the 3 stages of the method \(\)	4	4 x 3.3a	Marks can be awarded from labelled diagrams DO NOT ALLOW stages in incorrect order ALLOW idea of salt remaining after water is evaporated
	(b)	Sodium ion labelled as Na ⁺ and chloride ion labelled as $Cl^{-}\checkmark$ Alternately labelled ions \checkmark	2	2 x 1.2	DO NOT ALLOW atoms rather than ions; scores 0 marks ALLOW information provided in the form of a key IGNORE labelling as 'sodium ion' / 'chloride ion'; must be symbols

Questi	on	Answer	Marks	AO element	Guidance
(c)	(i)	This isotope contains 17 neutrons	2	2 x 2.1	All three correct = 2 marks Two correct = 1 mark
		This isotope has a full outer shell of electrons			
		This isotope has more protons than neutrons			
		This isotope has the highest mass number			
		This isotope has the same number of neutrons and protons			
	(ii)	First check the answer on answer line If answer = 121.3 award 2 marks	2	2 x 2.2	
		33 + (4 x 16) + 24.3 ✓ = 121.3 ✓			
	(iii)	Solvent / mobile phase ✓	1	3.3b	IGNORE use a different liquid IGNORE change the concentration of the solvent
					DO NOT ALLOW (change) the stationary phase
	(iv)	Strong electrostatic attraction (between oppositely charged ions) / strong forces between oppositely charged ions / strong ionic bonds ✓	2	2 x 2.1	DO NOT ALLOW references to intermolecular forces, covalent bonds or metallic bonds – scores 0 for question
		Lots of energy is required to overcome the forces / bonds 🗸			

Question		Answer	Marks	AO element	Guidance
21	(a)	(Substance) 3 ✓	3	3 x 2.1	(Substance) 1 or 2 scores 0 for the question
		And any two from: Polymers have low melting points / substance 3 has a low melting point ✓			IGNORE references to boiling point
		Polymers do not conduct electricity / substance 3 does not conduct electricity ✓			
		Polymers can be flexible / substance 3 is flexible ✓			ALLOW maximum 1 mark for a correct explanation if Substance 4 is chosen
	(b)	Idea that polymer <u>chains</u> without cross-links can slide or move over each other / ORA ✓	2	2 x 1.1	Assume unqualified answer refers to polymers without cross-links IGNORE references to the polymer chains stretching
		The intermolecular forces holding polymer chains together are weaker than cross-links / ORA ✓			ALLOW idea that cross-links are covalent bonds
	(c)	(Part A) - substance 3 AND (Part B) – substance 1 ✓	3	3 x 3.2a	DO NOT ALLOW named substances (e.g., plastic / metal) for MP1
		Explanations Part A needs to be an insulator / Part A needs to protect from electrical shock / Part A needs to be flexible (so wire can bend) ✓			ALLOW Part A does not conduct electricity
		Part B needs to conduct electricity ✓			MP2 and MP3 are independent of MP1

Q	Question		Answer	Marks	AO element	Guidance
22	(a)	(i)	First check the answer on answer line If answer = 7.2 (g) award 3 marks Moles of oxygen = $0.45 \div 2 = 0.225 \checkmark$ M _r of oxygen = $16 \times 2 = 32 \checkmark$ Mass of oxygen = $0.225 \times 32 = 7.2$ (g) \checkmark	3	3 x 2.1	ALLOW ECF from incorrect moles of oxygen
		(ii)	First check the answer on answer line If answer = 5.42×10^{23} award 3 marks Moles of NO ₂ = $0.45 \times 2 = 0.9 \checkmark$	3	3 x 2.1	and/or M _r of oxygen
			Molecules of NO ₂ = 0.9 x (6.02 x 10^{23}) = 5.418 x 10^{23} \checkmark 3 significant figures: = 5.42 x 10^{23} \checkmark			ALLOW ECF from incorrect moles of NO ₂ ALLOW ECF if significant figures correct from incorrect calculation of molecules of NO ₂

Question	Answer	Marks	AO element	Guidance
(b)	(A)	4	4 x 1.1	
	activation products Energy Energy change of reaction			ALLOW 1 mark MAX for correctly labelled activation energy on an exothermic reaction profile
	Reaction Progress			
	Products line labelled above reactant line ✓			
	Curve up, then down from reactant to products (on endothermic reaction profile) ✓			
	Activation energy labelled ✓			DO NOT ALLOW double headed arrow or line without arrow
	Energy change labelled ✓			DO NOT ALLOW double headed arrow or line without arrow

Q	Question		Answer	Marks	AO element	Guidance
	(c)	(i)	Idea that 2 electrons are lost to form a full outer shell ✓	1	2.1	ALLOW idea that magnesium has (only) 2 <u>outer</u> shell electrons which are lost / idea that magnesium loses 2 electrons to become stable IGNORE just the idea that magnesium loses 2 electrons
		(ii)	Mg ²⁺ + 2OH ⁻ → Mg(OH) ₂ Correct formulae ✓ Balancing ✓	2	2 x 2.1	ALLOW any correct multiple, including fractions ALLOW = instead of → DO NOT ALLOW and / & instead of '+' IGNORE state symbols DO NOT ALLOW Mg ²⁺ (OH) ⁻ ₂ ALLOW 1 mark for a balanced equation with a
						minor error in subscripts / formulae e.g., $Mg^{2+} + 2Oh^{-} \rightarrow Mg(OH)_{2}$

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