

Higher

GCSE

Chemistry A Gateway Science

J248/03: Paper 3 (Higher Tier)

General Certificate of Secondary Education

Mark Scheme for June 2025

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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.

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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 40% 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 the annotation 'SEEN' to confirm that the work has been seen and mark any responses using the annotations in section 11.

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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 is not 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.**
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 **Question 20**

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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

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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 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.

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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	B ✓	1	1.1	
2	B ✓	1	1.1	
3	B ✓	1	1.1	
4	A ✓	1	2.2	
5	C ✓	1	1.1	
6	C ✓	1	2.1	
7	A ✓	1	1.1	
8	A ✓	1	2.1	
9	A ✓	1	1.2	
10	D ✓	1	2.1	
11	D ✓	1	1.1	
12	B ✓	1	2.1	
13	A ✓	1	2.1	
14	B ✓	1	2.2	
15	B ✓	1	2.2	

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Question			Answer	Marks	AO element	Guidance
		(ii)	They can block ultraviolet light. ☐ They can catalyse harmful reactions in the body. ☒ They can have antibacterial properties. ☐ They can have toxic effects on the body. ☒ They have a high surface area to volume ratio. ☐ ✓✓	2	2 × 1.1	
	(c)		First check the answer on the answer line If answer = 0.6 or 0.6:1 or 1:1.7 award 3 marks Surface area = $6 \times 10^2 = 600$ ✓ Volume = $10^3 = 1000$ ✓ Surface area ÷ volume ratio = $600 \div 1000$ $= 0.6$ or $0.6:1$ or $1:1.7$ ✓	3	2 × 2.2 1.2	Units not needed ALLOW ECF from incorrect surface area and/or volume ALLOW 1 : 1.6666667 ALLOW 3:5 / 6:10 or any ratio consistent with 0.6:1 ALLOW ratio given as a fraction eg $\frac{3}{5}$, $\frac{600}{1000}$ DO NOT ALLOW ratio wrong way round eg 1:0.6

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Question			Answer	Marks	AO element	Guidance
17	(a)		A substance that contains only one (type of) atom or element or compound or molecule or particle ✓	1	1.1	IGNORE idea that pure substances have a fixed m.pt rather than a range of m.pt.s. IGNORE idea of only one substance
	(b)	(i)	Any two from: Start line drawn in pencil ✓ Idea of solvent below the start line ✓ Dots drawn further apart ✓	2	2 × 3.3b	ALLOW idea that dye (spots) must be above the solvent ALLOW water for solvent IGNORE add a lid (to stop the solvent evaporating)
		(ii)	Pink ✓ Idea that R_f value is in the range (0.40-0.80) ✓	2	2 × 3.2b	

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Question			Answer	Marks	AO element	Guidance
	(c)		First check the answer on the answer line If answer = 0.79 award 2 marks $R_f \text{ value} = 2.7 \div 3.4 \checkmark$ $= 0.79 \checkmark$	2	1.2 2.2	DO NOT ALLOW $3.4 \div 2.7$ ALLOW 0.8 or any correctly rounded value from 0.7941176471 ALLOW 0.80
	(d)		First check the answer on the answer line If answer = 7.89 / 7.9 award 2 marks $\frac{5.1}{9.7} = 0.5257732 \checkmark$ $0.5257732 \times 15 = 7.88659794 \checkmark$ OR $\frac{15.0}{9.7} = 1.5463917 \checkmark$ $1.5463917 \times 5.1 = 7.88659794 \checkmark$	2	2 × 2.2	ALLOW any correctly rounded value ALLOW $\frac{5.1}{9.7} = 0.53$ $0.53 \times 15 = 7.95$, provided working out is shown ALLOW ECF from MP1 ALLOW $\frac{15.0}{9.7} = 1.55$ $1.55 \times 5.1 = 7.91$, provided working out is shown ALLOW ECF from MP1

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Question			Answer	Marks	AO element	Guidance
18	(a)		Any four from: (Pour an appropriate volume of) copper sulfate (solution) into insulated cup ✓ Measure / record start temperature ✓ Add (magnesium) powder and stir ✓ Put on lid ✓ Measure / record maximum / final temperature ✓ Repeat experiment (three times) ✓ Calculate temperature change ✓	4	4 × 3.3a	Marks can be awarded from labelled diagrams ALLOW beaker / conical flask / boiling tube / test tube ALLOW mix / swirl for stir
	(b)		Idea that results are not similar / consistent ✓	1	3.1a	ALLOW the temperature for each experiment is different / the results cover a range (of 31)
	(c)	(i)	A ☒ B ☐ C ☐ ✓	1	1.1	
		(ii)	A ☐ B ☐ C ☒ ✓	1	1.1	

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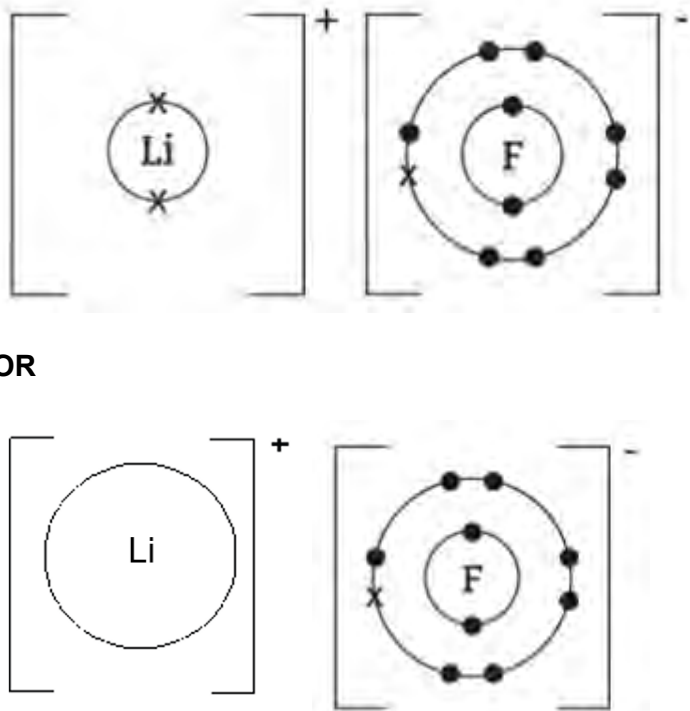
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Question			Answer	Marks	AO element	Guidance												
19	(a)		<table><tr><td>Subatomic particle</td><td>Relative mass</td><td>Relative charge</td></tr><tr><td>Electron</td><td>0.0005 / $\frac{1}{2000}$</td><td>-1 / 1-</td></tr><tr><td>Neutron</td><td>1</td><td>0 / neutral / no charge</td></tr><tr><td>Proton</td><td>1</td><td>+1</td></tr></table> ✓✓✓	Subatomic particle	Relative mass	Relative charge	Electron	0.0005 / $\frac{1}{2000}$	-1 / 1-	Neutron	1	0 / neutral / no charge	Proton	1	+1	3	3 × 1.1	ALLOW mass of electron as almost 0 / negligible / any quoted value which is negligible (≤ 0.00056) BUT DO NOT ALLOW mass as 0 / nothing DO NOT ALLOW just ‘–’ for charge on electron
Subatomic particle	Relative mass	Relative charge																
Electron	0.0005 / $\frac{1}{2000}$	-1 / 1-																
Neutron	1	0 / neutral / no charge																
Proton	1	+1																
	(b)		(Lithium atom) loses one electron / (lithium atom) loses the electron in its outer shell ✓	1	1.1													
	(c)		Element ✓ Protons ✓ Neutrons ✓	3	3 × 1.1	IGNORE electrons												

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Question	Answer	Marks	AO element	Guidance
(d)	 OR Correct lithium ion ✓ Correct fluoride ion ✓	2	2 × 2.1	Two correct electronic structures but no charges/incorrect charges award one mark Two correct charges with incorrect electronic structure award one mark The ionic charges must not be shown in the nucleus ALLOW answers showing the transfer of electrons providing the same electrons are not shown twice ALLOW electrons as all dots or all crosses or a mix of both Inner shell electrons do not need to be shown but must be correct if they are shown

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Question			Answer	Marks	AO element	Guidance
	(e)		First check the answer on the answer line If answer = 5.75×10^8 award 3 marks Atomic radius = 1×10^{-10} m / 0.1nm ✓ Unit conversion mark: $11.5 \text{ cm} = 0.115 \text{ m} / 1.15 \times 10^{-1} \text{ m} / 1.15 \times 10^8 \text{ nm}$ ✓ $0.115 \div (2 \times (1 \times 10^{-10})) = 5.75 \times 10^8$ OR $1.15 \times 10^8 \div 0.2 = 5.75 \times 10^8$ ✓	3	1.1 2 × 2.2	Units must be stated ALLOW ECF from incorrect atomic radius ALLOW any correct unit conversion, eg $11.5 \text{ cm} = 115 \text{ mm}$ ALLOW conversion of atomic radius to cm for this MP, ie $1 \times 10^{-10} \text{ m}$ or $0.1 \text{ nm} = 1 \times 10^{-8} \text{ cm}$ ALLOW ECF from incorrect unit conversion

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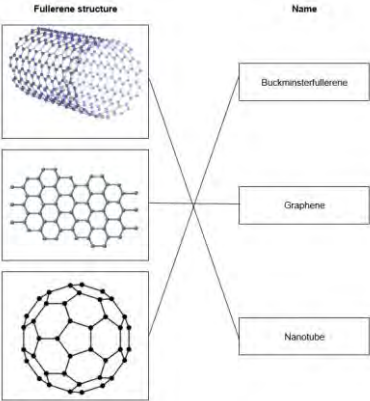
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Question			Answer	Marks	AO element	Guidance
20*			Please refer to the marking instructions on page 4 of this mark scheme for guidance on how to mark this question. Level 3 (5–6 marks) Demonstrates detailed knowledge and understanding of structure and bonding to identify the structure and bonding in all 3 structures AND Accurately applies knowledge and a detailed understanding to explain the properties of each substance. <i>There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.</i> Level 2 (3–4 marks) Demonstrates clear knowledge and understanding of structure and bonding to identify the structure and bonding in some of the structures AND Applies clear knowledge and understanding to explain the properties of some of the substances. <i>There is a line of reasoning presented with some structure. The information presented is relevant and supported by some evidence.</i> Level 1 (1–2 marks) Demonstrates limited knowledge and understanding of the structure and bonding in some of the structures OR Attempts to apply knowledge and understanding to explain the properties of some of the substances. <i>There is an attempt at a logical structure with a line of reasoning. The information is in the most part relevant.</i> 0 marks No response or no response worthy of credit.	6	2 × 1.1 4 × 3.2b	AO1.1 Demonstrates knowledge and understanding of structures and bonding. - Ionic compounds have high melting and boiling points due to strong electrostatic forces of attraction between oppositely charged ions which take lots of energy to overcome - Ionic compounds conduct electricity only when molten or in solution as the ions can move (but can't when solid) - Simple covalent molecules have low melting and boiling points as the weak intermolecular forces do not take much energy to overcome - Simple covalent molecules do not conduct electricity as they have no ions / delocalised electrons which can move - Metals have high melting and boiling points due to the strong electrostatic forces between the metal ions and the delocalised electrons which take lots of energy to overcome - Metals conduct electricity as they have delocalised electrons which can move. AO3.2b Analyse information and ideas to draw conclusions - J is ionic - K is simple covalent - L is metallic

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Question			Answer	Marks	AO element	Guidance
21	(a)		 Fullerene structure Name Buckminsterfullerene Graphene Nanotube ✓✓	2	2 × 1.1	All three lines correct = 2 marks One or two correct = 1 mark
	(b)	(i)	Delocalised electrons / free electrons / sea of electrons ✓ (electrons) can move / (electrons) carry a charge ✓	2	2 × 1.1	DO NOT ALLOW references to ions – scores 0 for question IGNORE spare electrons
		(ii)	(Graphite) has many strong covalent bonds ✓ which take a large amount of energy to break ✓	2	2 × 1.1	ALLOW giant/lattice structure with strong covalent bonds for idea of many strong covalent bonds DO NOT ALLOW references to intermolecular forces – scores 0 for question

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Question			Answer	Marks	AO element	Guidance																
22	(a)		$\text{CaCO}_3(\text{s}) + 2\text{HNO}_3(\text{aq}) \rightarrow \text{Ca}(\text{NO}_3)_2(\text{aq}) + \text{CO}_2(\text{g}) + \text{H}_2\text{O}(\text{l})$ Formulae ✓ Balancing ✓ State symbols ✓	3	2×2.1 1×1.1	ALLOW any correct multiple, including fractions ALLOW = for → DO NOT ALLOW and / & instead of '+' Balancing mark is dependent on the correct formulae but ALLOW 1 mark for a balanced equation with a minor error in subscripts / formulae e.g. $\text{CaCO}_3(\text{s}) + 2\text{HNO}_3(\text{aq}) \text{CA}(\text{NO}_3)_2(\text{aq}) + \text{CO}_2(\text{g}) + \text{H}_2\text{O}(\text{l})$																
	(b)	(i)	Linear scale on both axes ✓ All points plotted correctly ✓✓ <table border="1"><thead><tr><th>Time (s)</th><th>Volume of carbon dioxide (cm³)</th></tr></thead><tbody><tr><td>0</td><td>0</td></tr><tr><td>10</td><td>15</td></tr><tr><td>20</td><td>31</td></tr><tr><td>30</td><td></td></tr><tr><td>40</td><td>45</td></tr><tr><td>50</td><td>47</td></tr><tr><td>60</td><td>47</td></tr></tbody></table>	Time (s)	Volume of carbon dioxide (cm ³)	0	0	10	15	20	31	30		40	45	50	47	60	47	3	3×2.2	3 or 4 points plotted correctly scores 1 mark (0,0) need not be plotted but the curve must start at the origin ALLOW ±½ small square MP2&3 are dependent on MP1
Time (s)	Volume of carbon dioxide (cm ³)																					
0	0																					
10	15																					
20	31																					
30																						
40	45																					
50	47																					
60	47																					
		(ii)	Smooth curve through all points ✓	1	1.2	ALLOW correctly drawn curve of best fit through incorrectly plotted points DO NOT ALLOW straight line or dot-to-dot or tramlines																
		(iii)	Answer ± 1 cm ³ of their own graph ✓	1	3.2b																	
	(c)		Experiment 2 ✓ The same volume of gas is produced in a shorter period of time / more gas is produced in the same time / experiment 2 finishes in less time ✓	2	3.2b 3.1b	MP2 is dependent on MP1 ALLOW the volume rose quicker / gas or CO ₂ is produced faster / idea that the graph levels off sooner IGNORE the rate of reaction is faster																

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Question			Answer	Marks	AO element	Guidance
	(d)		(Gas) <u>syringe</u> / (upturned) burette ✓	1	3.3b	
	(e)		First check the answer on the answer line If answer = 246 award 4 marks M_r of $\text{Ca}(\text{NO}_3)_2 = 164.1$ ✓ Mass of $\text{Ca}(\text{NO}_3)_2 = \frac{164.1}{40.1} \times 60$ ✓ $= 245.5361$ ✓ 3 significant figures: $= 246$ ✓ OR M_r of $\text{Ca}(\text{NO}_3)_2 = 164.1$ ✓ Moles of Ca $= 60 \div 40.1 = 1.496259$ ✓ Mass of $\text{Ca}(\text{NO}_3)_2 = 1.496259 \times 164.1 = 245.536$ ✓ 3 significant figures: $= 246$ ✓	4	3×2.2 1×1.2	ALLOW ECF from incorrect M_r ALLOW 1 mark for clear evidence of incorrect answer correctly rounded to 3 significant figures ALLOW ECF from moles of Ca and/or from incorrect M_r ALLOW 245 for 4 marks if method 2 is used and it is clear that the candidate has rounded the number of moles of Ca (to 1.496)

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Question			Answer	Marks	AO element	Guidance													
	(f)		<table><tr><td>Acid</td><td>Concentration of hydrogen ions in solution (mol/dm³)</td><td>pH</td></tr><tr><td rowspan="2">Hydrochloric acid</td><td>1.0 × 10⁻¹</td><td>1.0</td></tr><tr><td>1.0 × 10⁻² / 0.01</td><td>2.0</td></tr><tr><td rowspan="2">Sulfuric acid</td><td>2.0 × 10⁻¹</td><td>0.7</td></tr><tr><td>2.0 × 10⁻³</td><td>2.7</td></tr></table> ✓✓	Acid	Concentration of hydrogen ions in solution (mol/dm ³)	pH	Hydrochloric acid	1.0 × 10 ⁻¹	1.0	1.0 × 10 ⁻² / 0.01	2.0	Sulfuric acid	2.0 × 10 ⁻¹	0.7	2.0 × 10 ⁻³	2.7	2	2 × 2.2	
Acid	Concentration of hydrogen ions in solution (mol/dm ³)	pH																	
Hydrochloric acid	1.0 × 10 ⁻¹	1.0																	
	1.0 × 10 ⁻² / 0.01	2.0																	
Sulfuric acid	2.0 × 10 ⁻¹	0.7																	
	2.0 × 10 ⁻³	2.7																	

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Question			Answer	Marks	AO element	Guidance
23	(a)		First check the answer on the answer line If answer = 76.0 / 76 (g) award 3 marks. Mole ratio $\text{Cr}_2\text{O}_3 : \text{Cr} = 1:2$ / moles of $\text{Cr}_2\text{O}_3 = 0.5$ ✓ M_r of $\text{Cr}_2\text{O}_3 = 152.0$ ✓ Mass of $\text{Cr}_2\text{O}_3 = 0.5 \times 152.0 = 76.0 / 76$ (g) ✓	3	3 × 2.2	ALLOW 152 ALLOW ECF from incorrect mole ratio and/or M_r
	(b)		First check the answer on the answer line If answer = 8.64×10^{-23} (g) award 2 marks. Mass of one atom of chromium = $52 \div 6.02 \times 10^{23}$ ✓ = $8.637873754 \times 10^{-23} / 8.64 \times 10^{-23}$ ✓	2	2 × 2.2	ALLOW $8.637873754 \times 10^{-23}$ or any correctly rounded value BUT DO NOT ALLOW 9×10^{-23}
	(c)		Anode $\text{Cr} \rightarrow \text{Cr}^{3+} + 3\text{e}^-$ Formulae ✓ Balancing ✓ Cathode $\text{Cr}^{3+} + 3\text{e}^- \rightarrow \text{Cr}$ Formulae ✓ Balancing ✓	4	4 × 2.2	ALLOW correct multiples ALLOW $\text{Cr} - 3\text{e}^- \rightarrow \text{Cr}^{3+}$

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