

# Higher

## GCSE

### Chemistry A Gateway Science

#### J248/04: Paper 4 (Higher Tier)

General Certificate of Secondary Education

#### Mark Scheme for June 2024

GRADEUP.UK

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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. 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.
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 question on this paper is **22d**.

## 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

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

<b>Annotation</b>	<b>Meaning</b>
/	alternative and acceptable answers for the same marking point
✓	Separates marking points
<b>DO NOT ALLOW</b>	Answers which are not worthy of credit
<b>IGNORE</b>	Statements which are irrelevant
<b>ALLOW</b>	Answers that can be accepted
( )	Words which are not essential to gain credit
—	Underlined words must be present in answer to score a mark
<b>ECF</b>	Error carried forward
<b>AW</b>	Alternative wording
<b>ORA</b>	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:

	<b>Assessment Objective</b>
<b>AO1</b>	<b>Demonstrate knowledge and understanding of scientific ideas and scientific techniques and procedures.</b>
AO1.1	Demonstrate knowledge and understanding of scientific ideas.
AO1.2	Demonstrate knowledge and understanding of scientific techniques and procedures.
<b>AO2</b>	<b>Apply knowledge and understanding of scientific ideas and scientific enquiry, techniques and procedures.</b>
AO2.1	Apply knowledge and understanding of scientific ideas.
AO2.2	Apply knowledge and understanding of scientific enquiry, techniques and procedures.
<b>AO3</b>	<b>Analyse information and ideas to interpret and evaluate, make judgements and draw conclusions and develop and improve experimental procedures.</b>
<b>AO3.1</b>	Analyse information and ideas to interpret and evaluate.
AO3.1a	Analyse information and ideas to interpret.
AO3.1b	Analyse information and ideas to evaluate.
<b>AO3.2</b>	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.
<b>AO3.3</b>	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	C ✓	1	2.1	
2	C ✓	1	2.1	
3	D ✓	1	1.1	
4	A ✓	1	1.1	
5	B ✓	1	1.1	
6	C ✓	1	2.1	
7	A ✓	1	1.1	
8	B ✓	1	2.1	
9	A ✓	1	1.1	
10	A ✓	1	1.1	
11	A ✓	1	1.1	
12	C ✓	1	1.1	
13	C ✓	1	1.1	
14	A ✓	1	2.1	
15	D ✓	1	2.1	

Question			Answer	Marks	AO element	Guidance
16	(a)	(i)	Melting point decreases (down the group) / Boiling point decreases (down the group) ✓	1	3.1a	<b>ALLOW ORA</b> <b>Assume unqualified answers refer to down the group</b> <b>IGNORE</b> references to density
		(ii)	Answer in range 35 – 10 (°C) ✓	1	3.2a	
	(b)	(i)	(Group 1 elements) all have 1 electron in the <u>outer</u> or <u>valence</u> shell / Idea that (Group 1 elements) all want to lose 1 electron to get a full or complete (outer) shell ✓	1	1.1	<b>ALLOW</b> (Group 1 elements) all have the same number of electrons in the <u>outer</u> or <u>valence</u> shell <b>ALLOW</b> idea that (Group 1 elements) all want to lose 1 electron to become stable
		(ii)	(Down the group) <u>outer</u> shell electron is further from the nucleus ✓ Less attraction between nucleus and <u>outer</u> shell electron / more shielding ✓ <u>Outer</u> electron is lost more easily ✓	3	3 x 1.1	<b>Reference to <u>outer</u> shell electron must be made at least once to award 3 marks</b> <b>Mark independently</b> <b>ALLOW</b> valence electron for outer shell electron <b>ALLOW</b> (Down the group) the atomic radius is larger / more (electron) shells (down the group) <b>DO NOT ALLOW</b> references to <u>intermolecular</u> forces <b>ALLOW</b> electrons in plural <b>IGNORE</b> <u>outer</u> electron is lost more quickly
		(iii)	$2\text{Na} + \text{Br}_2 \rightarrow 2\text{NaBr}$ Formulae ✓ Balancing ✓	2	2 x 2.1	<b>ALLOW</b> any correct multiple, including fractions <b>ALLOW</b> = for → <b>DO NOT ALLOW</b> and / & instead of '+' <b>IGNORE</b> state symbols  Balancing mark is dependent on the correct formulae but <b>ALLOW</b> 1 mark for a balanced equation with a minor error in subscripts / formulae e.g. $2\text{Na} + \text{Br}_2 \rightarrow 2\text{NaBr}$

Question		Answer	Marks	AO element	Guidance
	(c)	Any two from: They used hydrochloric acid ✓ (Hydrochloric acid) contains chloride ions ✓  Idea that experiment will give a positive result (for chloride ions) ✓  Nitric acid should have been used (instead of hydrochloric acid) ✓	2	2 x 2.2	<b>IGNORE</b> chlorine ions <b>ALLOW</b> (hydrochloric acid) contains chlorine

Question			Answer	Marks	AO element	Guidance
17	(a)	(i)	$\rightleftharpoons$ sign (in equation) ✓	1	1.1	<b>ALLOW</b> a description of the $\rightleftharpoons$ , e.g., the double arrow / the arrow pointing both ways / equilibrium symbol <b>IGNORE</b> just 'the reversible symbol' / the symbol in the middle <b>BUT ALLOW</b> ' the reversible arrow'
		(ii)	Idea of no loss or gain of reactants and products ✓	1	1.1	<b>ALLOW</b> 'substance(s)' for reactants / products <b>ALLOW</b> idea that that nothing can get <u>in or out</u> / a description of a closed system, e.g., a flask with a bung in <b>IGNORE</b> just no gas can escape
		(iii)	<p>Only ammonia, NH<sub>3</sub>, is being made. <input type="checkbox"/></p> <p>The amounts of reactants and products are constant. <input checked="" type="checkbox"/></p> <p>The forward and backward reactions are happening at the same rate. <input checked="" type="checkbox"/></p> <p>The forward reaction is faster than the backward reaction. <input type="checkbox"/></p> <p>The reaction has finished. <input type="checkbox"/></p> <p>✓✓</p>	2	2 x 1.1	
	(b)		(Change) temperature ✓	1	2.1	<b>ALLOW</b> increase or decrease <b>ALLOW</b> add more products / ammonia <b>IGNORE</b> concentration

Question		Answer	Marks	AO element	Guidance
	(c)	<p><b>First check the answer on the answer line</b>  <b>If answer = 77.5 or 78 (%) award 2 marks</b></p> <p>Percentage yield = <math>\frac{620}{800} \times 100 \checkmark</math>  <math>= 77.5 \text{ or } 78 (\%) \checkmark</math></p>	2	2 x 2.1	<p><b>ALLOW ECF</b>  <b>ALLOW</b> % yield = (am ÷ pm) x 100  for 1 mark if no other mark awarded</p>
	(d)	Idea that there is only one product / only ammonia is made ✓	1	2.1	<p><b>ALLOW</b> no waste product(s) or byproducts are made / all the products are useful</p> <p><b>IGNORE</b> no atoms lost / idea that everything is used / nothing is wasted / idea that mass of reactants equals mass of product(s)</p>

Question		Answer	Marks	AO element	Guidance
18	(a)	<p><b>Test tube 1</b> – a mass value &gt; 4.42(g) ✓</p> <p><b>Test tube 2</b> – 4.46(g) ✓</p>	2	2 x 3.2a	
	(b)	<p><b>Test tube 4</b> Idea that the scratch in the paint exposed the iron to air/oxygen and/or water (so it rusted) ✓</p> <p><b>Test tube 5</b> Idea that (even when the zinc coating is scratched) the zinc will corrode first ✓</p> <p>because zinc is more reactive (than iron) / zinc loses electrons more easily (than iron) ✓</p>	3	2 x 3.2b  1 x 1.2	<p><b>ALLOW</b> the iron reacted with the air/oxygen and/or water</p> <p><b>ALLOW</b> idea of sacrificial protection <b>DO NOT ALLOW</b> zinc will rust (first)</p>
	(c)	(i)			
		<p>Copper oxide / CuO loses oxygen or copper oxide / CuO is reduced ✓</p> <p>Carbon (atoms) / C gains oxygen or carbon (atoms) / C is oxidised ✓</p>	2	2 x 2.2	<p><b>DO NOT ALLOW</b> copper loses oxygen <b>BUT ALLOW</b> copper gains electrons / copper (cat)ions are reduced (to form copper atoms)</p> <p><b>ALLOW</b> carbon loses electrons</p>

Question	Answer	Marks	AO element	Guidance
(ii)	<p><b>First check the answer on the answer line</b>  <b>If answer = 12 (tonnes) award 3 marks</b>  <b>If answer = 12,000,000 g award 3 marks</b></p> <p>Mass of CuO = <math>15 \times \frac{63.5}{79.5}</math> or <math>15 \times \frac{127}{159}</math> ✓  <math>= 11.98</math> ✓</p> <p>To 2 <b>significant figures</b> = 12 (tonnes) ✓</p>	3	<p>2 x 2.2</p> <p>1 x 1.2</p>	<p><b>ALLOW ECF</b> marks for e.g., <math>15 \times \frac{79.5}{63.5} = 18.78</math>  and (to 2 sig figs) 19 (tonnes)</p> <p><b>ALLOW ECF</b> if significant figures are correct from an incorrect calculation of mass</p>
(iii)	<p><b>Quantitative answer:</b>  Pure copper is twice as conductive ✓  compared to 99% pure copper ✓</p> <p><b>BUT</b>  <b>Qualitative answer:</b>  Pure copper is a better conductor than 99% pure /  impure copper / ORA ✓</p>	2	2 x 3.2b	<p><b>ALLOW</b> answers quoting 2 correct values from the graph for 2 marks  e.g., 99% pure copper has relative electrical conductivity of about 49, but 100% pure copper has relative electrical conductivity of 100  <b>OR</b> e.g., copper extracted from copper oxide has a relative electrical conductivity of about 49, but when purified by electrolysis has relative electrical conductivity of 100</p> <p><b>ALLOW</b> idea that copper with less impurities is a better conductor / ORA</p>

Question		Answer	Marks	AO element	Guidance
19	(a)	$C_{10}H_{22}$ ✓	1	2.1	<b>DO NOT ALLOW</b> $C_{10}H_{22}$ / $C^{10}H^{22}$
	(b)	$CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$ Formulae ✓ Balancing ✓	2	2 x 2.1	<b>ALLOW</b> any correct multiple, including fractions <b>ALLOW</b> = for → <b>DO NOT ALLOW</b> and / & instead of '+' <b>IGNORE</b> state symbols  Balancing mark is dependent on the correct formulae but <b>ALLOW</b> 1 mark for a balanced equation with a minor error in subscripts / formulae e.g. $Ch_4 + 2O_2 \rightarrow Co_2 + 2H_2O$
	(c)	Carbon / C ✓	1	1.1	<b>ALLOW</b> soot <b>IGNORE</b> particulates
	(d)	Idea that (fractionating) column has a temperature gradient and is cooler at the top ✓  Idea that LPG fraction contains small molecules / propane and/or butane are small molecules ✓  Intermolecular forces between smaller molecules are weak(er) / intermolecular forces between propane and/or butane are weak(er) / LPG has weak(er) intermolecular forces ✓  The weaker the intermolecular forces the lower the boiling point or less energy is required to break these forces ✓	4	4 x 1.1	<b>ALLOW</b> short chain for small molecules  <b>ALLOW</b> bonds between molecules for forces between molecules <b>DO NOT ALLOW</b> references to covalent bonds  <b>ALLOW</b> fewer intermolecular forces for weak(er) intermolecular forces  <b>ALLOW</b> heat for energy <b>DO NOT ALLOW</b> references to covalent bonds
	(e)	<u>Petrochemical</u> ✓	1	1.1	

Question		Answer	Marks	AO element	Guidance
19	(f)	<div style="display: flex; flex-direction: column; align-items: flex-start;"> <div style="border: 1px solid black; padding: 5px; margin-bottom: 10px;">Made by an addition reaction between an alkene and hydrogen, H<sub>2</sub></div> <div style="border: 1px solid black; padding: 5px; margin-bottom: 10px;">Made when propanol is oxidised</div> <div style="border: 1px solid black; padding: 5px; margin-bottom: 10px;">Made when propene reacts with bromine water</div> <div style="border: 1px solid black; padding: 5px;">Made in a condensation polymerisation reaction</div> </div> <div style="display: flex; flex-direction: column; align-items: center; margin-top: 20px;"> <div style="border: 1px solid black; padding: 5px; text-align: center;"> <math display="block">\begin{array}{c} \text{H} &amp; \text{H} &amp; &amp; \text{O} \\   &amp;   &amp; &amp; // \\ \text{H}-\text{C} &amp; -\text{C} &amp; - &amp; \text{C} \\   &amp;   &amp; &amp; \backslash \\ \text{H} &amp; \text{H} &amp; &amp; \text{O}-\text{H} \end{array}</math> </div> <div style="border: 1px solid black; padding: 5px; text-align: center; margin: 5px 0;"> <math display="block">\begin{array}{c} \text{H} &amp; \text{H} &amp; \text{H} \\   &amp;   &amp;   \\ \text{H}-\text{C} &amp; -\text{C} &amp; -\text{C}-\text{H} \\   &amp;   &amp;   \\ \text{H} &amp; \text{Br} &amp; \text{Br} \end{array}</math> </div> <div style="border: 1px solid black; padding: 5px; text-align: center; margin: 5px 0;"> <math display="block">\left[ \begin{array}{c} \text{H} &amp; \text{Br} \\   &amp;   \\ -\text{C} &amp; - &amp; \text{C}- \\   &amp;   \\ \text{H} &amp; \text{H} \end{array} \right]_n</math> </div> <div style="border: 1px solid black; padding: 5px; text-align: center; margin: 5px 0;"> <math display="block">\begin{array}{c} \text{H} &amp; \text{H} &amp; \text{H} \\   &amp;   &amp;   \\ \text{H}-\text{C} &amp; -\text{C} &amp; -\text{C}-\text{H} \\   &amp;   &amp;   \\ \text{H} &amp; \text{H} &amp; \text{H} \end{array}</math> </div> <div style="border: 1px solid black; padding: 5px; text-align: center; margin: 5px 0;"> <math display="block">\left[ \begin{array}{c} \text{H} &amp; \text{H} &amp; &amp; \text{O} &amp; \text{H} &amp; \text{H} &amp; &amp; \text{O} \\   &amp;   &amp; &amp;    &amp;   &amp;   &amp; &amp;    \\ -\text{O}-\text{C} &amp; -\text{C} &amp; -\text{O}- &amp; \text{C} &amp; -\text{C} &amp; -\text{C} &amp; - &amp; \text{C}- \\   &amp;   &amp; &amp;   &amp;   &amp;   &amp; &amp;   \\ \text{H} &amp; \text{H} &amp; &amp; \text{H} &amp; \text{H} &amp; \text{H} &amp; &amp; \text{H} \end{array} \right]_n</math> </div> </div> <p style="text-align: right; margin-top: 10px;">✓✓✓✓</p>	4	4 x 2.1	

Question		Answer	Marks	AO element	Guidance
20	(a)	The Earth cooled, and water vapour condensed / the Earth cooled, and water vapour turned to water ✓  (Water vapour condensed) to form oceans ✓  Plants or algae evolved <u>and</u> used <u>photosynthesis</u> to take in carbon dioxide and make oxygen ✓	3	3 x 1.1	<b>ALLOW MAX 2</b> marks if processes not in the correct order
	(b)	(i)	1	3.1a	<b>IGNORE</b> references to proportionality
		(ii)	1	3.1a	
	(c)	(i)	3	3 x 3.1a	<b>ALLOW</b> higher amount of hydrogen / H <sup>+</sup> ions <b>ALLOW</b> just the idea that as the amount of sulfur dioxide increases the higher the hydrogen ion / H <sup>+</sup> concentration for 1 mark, if no other mark awarded
		(ii)	1	3.1a	<b>ALLOW</b> a named form of renewable energy e.g., solar panels, wind turbines, tidal turbines  <b>ALLOW</b> idea that the amount of sulfur dioxide (in the atmosphere) has decreased

Question		Answer	Marks	AO element	Guidance	
21	(a)	<p>Add indicator, e.g., phenolphthalein or methyl orange or litmus, to the (hydrochloric) acid in the conical flask ✓</p> <p>Add the sodium hydroxide (from the burette) ✓</p> <p>Swirl the conical flask (after adding the sodium hydroxide) ✓</p> <p>Idea of dropwise addition at the end point / until the indicator just changes colour ✓</p> <p>Colour change of indicator:            Phenolphthalein – colourless to pink            Methyl orange – red to yellow            Litmus – red to blue ✓</p>	5	5 x 1.2	<p><b>DO NOT ALLOW</b> universal indicator</p> <p><b>ALLOW</b> shake / mix for swirl <b>BUT IGNORE</b> stir</p> <p><b>ALLOW</b> dropwise addition throughout the titration</p> <p><b>IGNORE</b> clear for colourless</p>	
	(b)	(i)	Results within 0.1(0) (cm <sup>3</sup> ) of each other ✓	1	1.2	<p><b>ALLOW</b> Results within 0.2(0) (cm<sup>3</sup>) of each other</p> <p><b>IGNORE</b> results which are similar</p>

Question			Answer	Marks	AO element	Guidance
21	(b)	(ii)	<p>First check the answer on the answer line If answer = 7.5 (cm<sup>3</sup>) award 4 marks</p> <p>moles of acid = <math>\frac{0.12 \times 25.0}{1000} / 0.12 \times 0.025</math> 0.003 / 3.0 x10<sup>-3</sup> ✓</p> <p>idea that moles of alkali = moles acid / 1:1 ratio or moles of alkali = 0.003 / 3.0 x10<sup>-3</sup> ✓</p> <p>volume of alkali = <math>\frac{0.003}{0.4} = 0.0075 \text{ dm}^3</math> ✓  = 7.5 cm<sup>3</sup> ✓</p>	4	4 x 2.2	<p><b>ALLOW ECF</b> from moles of acid</p> <p><b>ALLOW ECF</b> from moles of alkali i.e. volume = <math>\frac{\text{moles}}{0.4}</math></p> <p><b>ALLOW ECF</b> for conversion of dm<sup>3</sup> to cm<sup>3</sup></p>

Question			Answer	Marks	AO element	Guidance
22	(a)	(i)	(Gas) <u>syringe</u> / (upturned) burette ✓	1	2.2	
		(ii)	Idea that marble chips are left over at the end of the reaction / marble chips are in excess ✓	1	2.2	<b>IGNORE</b> idea that hydrochloric acid was used up first
	(b)		Tangent drawn at 60 seconds ✓  Rate = $\frac{\text{y-step}}{\text{x-step}} = \frac{71 - 20}{120}$ ✓  = 0.425 / 0.43 / 0.4 (cm <sup>3</sup> /s) ✓	3	3 x 2.2	<b>ALLOW ECF</b> for y-step and x-step from incorrect tangent / attempted tangent  <b>ALLOW</b> answers in range 0.4 – 0.5 (cm <sup>3</sup> /s) <b>ALLOW ECF</b> for correct rate from incorrect y-step and x-step
	(c)	(i)	Stays the same / <b>AW</b> ✓	1	1.2	
		(ii)	Stays the same / <b>AW</b> ✓	1	1.2	

Question	Answer	Marks	AO element	Guidance
22 (d)*	<p>Please refer to the marking instructions on page 4 of this mark scheme for guidance on how to mark this question.</p> <p><b>Level 3 (5–6 marks)</b>  <b>Analyses the results to conclude that experiment 2 has the faster rate of reaction and suggests how the experiment could be improved.</b>  <b>Applies knowledge and understanding to give a detailed explanation, involving both surface area and temperature, why experiment 2 is faster.</b>  <i>There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.</i></p> <p><b>Level 2 (3–4 marks)</b>  <b>Analyses the results to conclude that experiment 2 has the faster rate of reaction OR suggests how the experiment could be improved</b>  <b>AND</b>  <b>Applies knowledge and understanding to clearly explain the difference in the rate of reaction.</b>  <i>There is a line of reasoning presented with some structure. The information presented is relevant and supported by some evidence.</i></p> <p><b>Level 1 (1–2 marks)</b>  <b>Analyses the results to conclude that experiment 2 has the faster rate of reaction</b>  <b>OR</b>  <b>Suggests how the experiment could be improved</b>  <b>OR</b>  <b>Applies knowledge and understanding to attempt to explain the difference in the rate of reaction.</b>  <i>There is an attempt at a logical structure with a line of reasoning. The information is in the most part relevant.</i></p> <p><b>0 marks</b>  <i>No response or no response worthy of credit.</i></p>	6	2 x 2.2 2 x 3.2b 2 x 3.3b	<p><b>AO3.2b Analyses information to draw conclusions</b></p> <ul style="list-style-type: none"> <li>The data shows that experiment 2 has a faster <b>rate</b>.</li> </ul> <p><b>AO2.2 Applies knowledge &amp; understanding to explain results</b></p> <ul style="list-style-type: none"> <li>Experiment 2 is faster because the magnesium is in smaller pieces (than experiment 1).</li> <li>Smaller pieces have a larger surface area so there is a higher collision frequency, and the reaction is faster.</li> <li>Experiment 2 is faster because the temperature of the acid is higher (than experiment 1).</li> <li>Higher temperature means that the particles move faster / have more energy.</li> <li>There is a higher frequency of (successful) collisions, and the reaction is faster.</li> </ul> <p><b>AO3.3b Analyses information to improve experimental procedures</b></p> <ul style="list-style-type: none"> <li>The experiment could be improved by only changing one variable (size of magnesium / temperature of acid) at a time</li> </ul>

