



Higher

GCSE

Chemistry A Gateway Science

J248/04: Paper 4 (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. 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
^K	Omission mark
BOD	Benefit of doubt given
CON	Contradiction
RE	Rounding error
SF	Error in number of significant figures
ECF	Error carried forward
L1	Level 1
L2	Level 2
L3	Level 3
NBOD	Benefit of doubt not given
SEEN	Noted but no credit given
I	Ignore

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.

J248/04

Mark Scheme

June 2024

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.

J248/04

Mark Scheme

June 2024

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	

J248/04

Mark Scheme

June 2024

Question			Answer	Marks	AO element	Guidance
16	(a)	(i)	Melting point decreases (down the group) / Boiling point decreases (down the group) ✓	1	3.1a	ALLOW ORA Assume unqualified answers refer to down the group IGNORE 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	ALLOW (Group 1 elements) all have the same number of electrons in the <u>outer</u> or <u>valence</u> shell ALLOW 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	Reference to <u>outer</u> shell electron must be made at least once to award 3 marks Mark independently ALLOW valence electron for outer shell electron ALLOW (Down the group) the atomic radius is larger / more (electron) shells (down the group) DO NOT ALLOW references to <u>intermolecular</u> forces ALLOW electrons in plural IGNORE <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	ALLOW any correct multiple, including fractions ALLOW = for → DO NOT ALLOW and / & instead of '+' IGNORE state symbols 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. $2\text{NA} + \text{Br}_2 \rightarrow 2\text{NaBr}$

J248/04

Mark Scheme

June 2024

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

J248/04

Mark Scheme

June 2024

Question		Answer	Marks	AO element	Guidance
17	(a)	(i) \rightleftharpoons sign (in equation) ✓	1	1.1	ALLOW a description of the \rightleftharpoons , e.g., the double arrow / the arrow pointing both ways / equilibrium symbol IGNORE just 'the reversible symbol' / the symbol in the middle BUT ALLOW 'the reversible arrow'
		(ii) Idea of no loss or gain of reactants and products ✓	1	1.1	ALLOW 'substance(s)' for reactants / products ALLOW 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 IGNORE just no gas can escape
	(iii)	Only ammonia, NH_3 , is being made. The amounts of reactants and products are constant. The forward and backward reactions are happening at the same rate. The forward reaction is faster than the backward reaction. The reaction has finished. ✓✓	2	2 x 1.1	
	(b)	(Change) temperature ✓	1	2.1	ALLOW increase or decrease ALLOW add more products / ammonia IGNORE concentration

J248/04

Mark Scheme

June 2024

Question		Answer	Marks	AO element	Guidance
	(c)	<p>First check the answer on the answer line If answer = 77.5 or 78 (%) award 2 marks</p> <p>Percentage yield = $\frac{620}{800} \times 100$ ✓ $= 77.5$ or 78 (%) ✓</p>	2	2 x 2.1	<p>ALLOW ECF ALLOW % yield = $(am \div pm) \times 100$ 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>ALLOW no waste product(s) or byproducts are made / all the products are useful</p> <p>IGNORE no atoms lost / idea that everything is used / nothing is wasted / idea that mass of reactants equals mass of product(s)</p>

J248/04

Mark Scheme

June 2024

Question		Answer	Marks	AO element	Guidance
18	(a)	<p>Test tube 1 – a mass value > 4.42(g) ✓</p> <p>Test tube 2 – 4.46(g) ✓</p>	2	2 x 3.2a	
	(b)	<p>Test tube 4 Idea that the scratch in the paint exposed the iron to air/oxygen and/or water (so it rusted) ✓</p> <p>Test tube 5 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	<p>2 x 3.2b</p> <p>1 x 1.2</p>	<p>ALLOW the iron reacted with the air/oxygen and/or water</p> <p>ALLOW idea of sacrificial protection DO NOT ALLOW zinc will rust (first)</p>
	(c)	<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>DO NOT ALLOW copper loses oxygen BUT ALLOW copper gains electrons / copper (cat)ions are reduced (to form copper atoms)</p> <p>ALLOW carbon loses electrons</p>

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

J248/04

Mark Scheme

June 2024

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

J248/04

Mark Scheme

June 2024

Question		Answer	Marks	AO element	Guidance
19	(f)	<p>Made by an addition reaction between an alkene and hydrogen, H_2</p> <p>Made when propanol is oxidised</p> <p>Made when propene reacts with bromine water</p> <p>Made in a condensation polymerisation reaction</p> <div style="display: flex; justify-content: space-around; align-items: flex-end;"> <div style="text-align: center;"> </div> </div> <p style="text-align: center;">✓✓✓✓</p>	4	4 x 2.1	

J248/04

Mark Scheme

June 2024

Question		Answer	Marks	AO element	Guidance
20	(a)	<p>The Earth cooled, and water vapour condensed / the Earth cooled, and water vapour turned to water ✓</p> <p>(Water vapour condensed) to form oceans ✓</p> <p>Plants or algae evolved <u>and</u> used <u>photosynthesis</u> to take in carbon dioxide and make oxygen ✓</p>	3	3 x 1.1	ALLOW MAX 2 marks if processes not in the correct order
	(b)	(i) As the percentage of carbon dioxide decreases, the percentage of nitrogen increases / ORA ✓	1	3.1a	IGNORE references to proportionality
		(ii) Answer in range 1700 – 1600 (millions of years) ✓	1	3.1a	
	(c)	<p>(i) Idea that as the amount of sulfur dioxide increases, the pH (of the rainwater) decreases / ORA ✓</p> <p>(the lower the pH) the more acidic the water / ORA ✓</p> <p>(so) the higher the hydrogen ion / H^+ concentration / ORA ✓</p>	3	3 x 3.1a	<p>ALLOW higher amount of hydrogen / H^+ ions</p> <p>ALLOW just the idea that as the amount of sulfur dioxide increases the higher the hydrogen ion / H^+ concentration for 1 mark, if no other mark awarded</p>
		(ii) Idea of less acid rain because of less use of fossil fuels / more use of renewable energy OR of using cars less / using mass transportation e.g., trains or buses OR of reducing energy consumption in homes ✓	1	3.1a	<p>ALLOW a named form of renewable energy e.g., solar panels, wind turbines, tidal turbines</p> <p>ALLOW idea that the amount of sulfur dioxide (in the atmosphere) has decreased</p>

J248/04

Mark Scheme

June 2024

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>DO NOT ALLOW universal indicator</p> <p>ALLOW shake / mix for swirl BUT IGNORE stir</p> <p>ALLOW dropwise addition throughout the titration</p> <p>IGNORE clear for colourless</p>	
	(b)	(i)	Results within 0.1(0) (cm ³) of each other ✓	1	1.2	<p>ALLOW Results within 0.2(0) (cm³) of each other</p> <p>IGNORE results which are similar</p>

J248/04

Mark Scheme

June 2024

Question		Answer	Marks	AO element	Guidance
21	(b)	<p>First check the answer on the answer line If answer = 7.5 (cm³) award 4 marks</p> <p>moles of acid = $\frac{0.12 \times 25.0}{1000} / 0.12 \times 0.025$ / 0.003 / 3.0 x10⁻³ ✓</p> <p>idea that moles of alkali = moles acid / 1:1 ratio or moles of alkali = 0.003 / 3.0 x10⁻³ ✓</p> <p>volume of alkali = $\frac{0.003}{0.4} = 0.0075$ dm³ ✓ = 7.5 cm³ ✓</p>	4	4 x 2.2	<p>ALLOW ECF from moles of acid</p> <p>ALLOW ECF from moles of alkali i.e. volume = $\frac{\text{moles}}{0.4}$</p> <p>ALLOW ECF for conversion of dm³ to cm³</p>

J248/04

Mark Scheme

June 2024

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	IGNORE idea that hydrochloric acid was used up first
	(b)		Tangent drawn at 60 seconds ✓ Rate = $\frac{y\text{-step}}{x\text{-step}} = \frac{71 - 20}{120}$ ✓ $= 0.425 / 0.43 / 0.4$ (cm ³ /s) ✓	3	3 x 2.2	ALLOW ECF for y-step and x-step from incorrect tangent / attempted tangent ALLOW answers in range 0.4 – 0.5 (cm ³ /s) ALLOW ECF for correct rate from incorrect y-step and x-step
	(c)	(i)	Stays the same / AW ✓	1	1.2	
		(ii)	Stays the same / AW ✓	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>Level 3 (5–6 marks) Analyses the results to conclude that experiment 2 has the faster rate of reaction and suggests how the experiment could be improved. Applies knowledge and understanding to give a detailed explanation, involving both surface area and temperature, why experiment 2 is faster. <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>Level 2 (3–4 marks) Analyses the results to conclude that experiment 2 has the faster rate of reaction OR suggests how the experiment could be improved AND Applies knowledge and understanding to clearly explain the difference in the rate of reaction. <i>There is a line of reasoning presented with some structure. The information presented is relevant and supported by some evidence.</i></p> <p>Level 1 (1–2 marks) Analyses the results to conclude that experiment 2 has the faster rate of reaction OR Suggests how the experiment could be improved OR Applies knowledge and understanding to attempt to explain the difference in the rate of reaction. <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>0 marks <i>No response or no response worthy of credit.</i></p>	6	2 x 2.2 2 x 3.2b 2 x 3.3b	AO3.2b Analyses information to draw conclusions <ul style="list-style-type: none"> The data shows that experiment 2 has a faster rate. AO2.2 Applies knowledge & understanding to explain results <ul style="list-style-type: none"> Experiment 2 is faster because the magnesium is in smaller pieces (than experiment 1). Smaller pieces have a larger surface area so there is a higher collision frequency, and the reaction is faster. Experiment 2 is faster because the temperature of the acid is higher (than experiment 1). Higher temperature means that the particles move faster / have more energy. There is a higher frequency of (successful) collisions, and the reaction is faster. AO3.3b Analyses information to improve experimental procedures <ul style="list-style-type: none"> The experiment could be improved by only changing one variable (size of magnesium / temperature of acid) at a time

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