

Foundation

GCSE

Chemistry A Gateway Science

J248/04: Paper 4 (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**.

11. Annotations available in RM Assessor

Annotation	Meaning
	Correct response
	Incorrect response
	Omission mark
	Benefit of doubt given
	Contradiction
	Rounding error
	Error in number of significant figures
	Error carried forward
	Level 1
	Level 2
	Level 3
	Benefit of doubt not given
	Noted but no credit given
	Ignore

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

Annotation	Meaning
/	Alternative and acceptable answers for the same marking point
✓	Separates marking points
DO NOT ALLOW	Answers which are not worthy of credit
IGNORE	Statements which are irrelevant
ALLOW	Answers that can be accepted
()	Words which are not essential to gain credit
<u>—</u>	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:

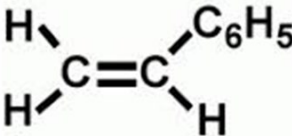
	Assessment Objective
AO1	Demonstrate knowledge and understanding of scientific ideas and scientific techniques and procedures.
AO1.1	Demonstrate knowledge and understanding of scientific ideas.
AO1.2	Demonstrate knowledge and understanding of scientific techniques and procedures.
AO2	Apply knowledge and understanding of scientific ideas and scientific enquiry, techniques and procedures.
AO2.1	Apply knowledge and understanding of scientific ideas.
AO2.2	Apply knowledge and understanding of scientific enquiry, techniques and procedures.
AO3	Analyse information and ideas to interpret and evaluate, make judgements and draw conclusions and develop and improve experimental procedures.
AO3.1	Analyse information and ideas to interpret and evaluate.
AO3.1a	Analyse information and ideas to interpret.
AO3.1b	Analyse information and ideas to evaluate.
AO3.2	Analyse information and ideas to make judgements and draw conclusions.
AO3.2a	Analyse information and ideas to make judgements.
AO3.2b	Analyse information and ideas to draw conclusions.
AO3.3	Analyse information and ideas to develop and improve experimental procedures.
AO3.3a	Analyse information and ideas to develop experimental procedures.
AO3.3b	Analyse information and ideas to improve experimental procedures.

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

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
16	(a)	(i)	Nitric acid ✓	1	3.3b	ALLOW HNO ₃ IGNORE dilute / concentrated Name takes precedence over formula
		(ii)	Hydrochloric acid contains chloride ions / Cl ⁻ ✓ Idea that these ions would give a precipitate (which would interfere with the test) ✓	2	2 x 3.3b	IGNORE chlorine ions ALLOW (hydrochloric acid) contains chlorine Mark independently
	(b)		Solution A = Bromide ✓ Solution B = Sulfate ✓	2	2 x 3.2b	ALLOW Br ⁻ DO NOT ALLOW bromine DO NOT ALLOW silver bromide ALLOW SO ₄ ²⁻ DO NOT ALLOW sulfur DO NOT ALLOW barium sulfate Name takes precedence over formula
	(c)		$\text{Cu}^{2+}(\text{aq}) + 2\text{OH}^{-}(\text{aq}) \rightarrow \text{Cu}(\text{OH})_2(\text{s})$ Formulae ✓ Balancing ✓ State symbols ✓	3	3 x 2.2	ALLOW any correct multiple, including fractions DO NOT ALLOW and / & instead of '+' DO NOT ALLOW Cu ²⁺ (OH ⁻) ₂ 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., $\text{Cu}^{2+}(\text{aq}) + 2\text{Oh}^{-}(\text{aq}) \rightarrow \text{CU}(\text{OH})_2(\text{s})$ Mark for state symbols dependent on correct species

Question			Answer	Marks	AO element	Guidance
	(d)		First check the answer on answer line If answer = 0.53 (g) award 3 marks Conversion of cm^3 to dm^3: $25 \div 1000 = 0.025 \text{ dm}^3$ ✓ mass = concentration x volume = 21×0.025 = 0.525 (g) ✓ OR Conversion of g/dm^3 to g/cm^3: $21 \text{ g/dm}^3 = 0.021 \text{ g/cm}^3$ ✓ mass = concentration x volume = 0.021×25 = 0.525 (g) ✓ 2 significant figures = 0.53 (g) ✓	3		2 x 2.2 ALLOW ECF from incorrect volume 0.525 without working scores 2 marks 1.2 ALLOW ECF if significant figures are correct from incorrect calculation of mass

Question			Answer	Marks	AO element	Guidance
17	(a)		B ✓ Any two from: Idea that (B) will not soften (when filled with a hot drink) ✓ Idea that (B) will hold its shape ✓ Idea that (B) will not melt (when filled with a hot drink) ✓ Idea that (B) is the <u>strongest</u> / <u>stronger</u> (than others) ✓	3	3 x 3.2a	Mark is for a valid reason and not just for picking a property from the table IGNORE (B) has a high softening temperature unless qualified IGNORE (B) has a high melting point unless qualified ALLOW (B) has a high tensile strength / is strong, if qualified ALLOW C with idea that (C) will not melt (when filled with a hot drink) for 1 mark only
	(b)		 Double bond between C atoms ✓ Rest of structure correct ✓	2	2 x 2.1	DO NOT ALLOW multiple double bonds ALLOW C₆H₅ group in any position ALLOW bond from C to H of C₆H₅ group IGNORE any square brackets / n MP2 is dependent on MP1

Question			Answer	Marks	AO element	Guidance
	(c)		Monomer Polymer amino acids DNA nucleotides proteins sugars starch ✓✓	2	2 x 1.1	All 3 correct = 2 marks 1 correct = 1 mark

Question			Answer	Marks	AO element	Guidance
18	(a)		$2\text{HCl} + \text{Mg} \rightarrow \text{MgCl}_2 + \text{H}_2$ Formulae ✓ Balancing ✓	2	2 x 2.2	ALLOW any correct multiple, including fractions 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., $2\text{HCL} + \text{Mg} \rightarrow \text{MgCl2} + \text{h}_2$
	(b)		Idea that the reaction (with magnesium powder) takes less time the more concentrated the (hydrochloric) acid / AW ✓	1	3.1b	IGNORE just quoting data from the table
	(c)	(i)	60 (s) ✓	1	2.2	
		(ii)	Line drawn above line for magnesium powder ✓ Line follows same general shape as line for magnesium powder ✓	2	2 x 2.2	ALLOW line starting at (0.5,117) MP2 is dependent on MP1
	(d)		First check the answer on answer line If answer = 96 (cm³) award 4 marks M_r of $\text{H}_2 = 2.0$ ✓ Moles of $\text{H}_2 = \frac{0.008}{2} / 0.004$ ✓ Volume of $\text{H}_2 = 0.004 \times 24 / 0.096 \text{ dm}^3$ ✓ Volume of H_2 in $\text{cm}^3 = 96 (\text{cm}^3)$ ✓	4	3 x 2.2 1.2	ALLOW ECF from incorrect M_r ALLOW ECF from incorrect moles calculation ALLOW ECF from volume in dm^3

Question			Answer	Marks	AO element	Guidance
19*			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) Analyses the information to give a clear and detailed comparison of the environmental impacts of each car over its lifetime. AND Applies knowledge and understanding of scientific ideas to give a detailed evaluation of the difference in emissions with an explanation of why a steel car has the smallest environmental impact. <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) Analyses the information to give a clear comparison of some of the environmental impacts of each car over its lifetime and suggests which car has the smallest environmental impact with some reasoning. OR Applies knowledge and understanding of scientific ideas to give a clear evaluation of the difference in emissions with an explanation of which car has the smallest environmental impact. <i>There is a line of reasoning presented with some structure.</i> <i>The information presented is relevant and supported by some evidence.</i>	6	2 x 2.1 4 x 3.2a	AO3.2a Analyse ideas and information to make judgements and AO2.1 Apply knowledge and understanding of scientific ideas Production • extraction of aluminium from aluminium ore uses electrolysis which uses lots of energy • due to energy required for electrolysis production of aluminium, it produces the most CO₂ emissions • iron (for steel) is extracted by heating iron ore with carbon • this requires less energy (than electrolysis) so produces less CO₂ emissions Driving • aluminium has a lower density (than iron) so has better fuel economy and reduces CO₂ emissions End of life • aluminium’s higher CO₂ emissions when producing the metal mean that there is a greater saving (than with iron) on CO₂ emissions by recycling the metal Overall • lifetime CO₂ emission for aluminium is 42 408kg, compared to 41 952kg for steel/iron • steel/iron therefore has the least environmental impact

Question			Answer	Marks	AO element	Guidance
			Level 1 (1–2 marks) Analyses the information to compare an environmental impact of each car. OR Applies some knowledge and understanding of scientific ideas to attempt an explanation of the difference in emissions in one of the three life-cycle stages. <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 <i>No response or no response worthy of credit.</i>			

Question			Answer	Marks	AO element	Guidance
20	(a)		$2\text{C}_4\text{H}_{10} + 13\text{O}_2 \rightarrow 8\text{CO}_2 + 10\text{H}_2\text{O}$ OR $\text{C}_4\text{H}_{10} + 6\frac{1}{2}\text{O}_2 \rightarrow 4\text{CO}_2 + 5\text{H}_2\text{O}$ Formulae ✓ Balancing ✓	2	2 x 2.2	ALLOW any correct multiple, including fractions 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., $\text{C}_4\text{H}_{10} + 6\frac{1}{2}\text{O}_2 \rightarrow 4\text{CO}_2 + 5\text{H}_2\text{O}$
	(b)		Idea that the higher the number of carbon atoms the less the energy given out / ORA ✓	1	3.1a	
	(c)	(i)	Any value in range 375 – 400 (°C) ✓	1	3.2a	Note – Boiling point of tetracosane is 391°C
		(ii)	Any three from: Octacosane has a higher boiling point ✓ Octacosane contains large(r) molecules ✓ Idea that the (fractionating) column is hotter at the bottom / cooler at the top ✓ The larger the molecule the greater or stronger the intermolecular forces ✓ The greater or stronger the intermolecular forces the more energy needed to break them ✓ The greater or stronger the intermolecular forces the higher the boiling point ✓ The more energy needed to break the intermolecular forces the higher the boiling point ✓	3	3 x 1.1	ALLOW fractions lower down the fractionating column for octacosane IGNORE melting point ALLOW octacosane is a long hydrocarbon chain / idea that octacosane contains more carbon atoms ALLOW the larger the molecule the more intermolecular forces ALLOW intermolecular bonds for intermolecular forces

Question			Answer	Marks	AO element	Guidance
	(d)		$(C_{28}H_{58} \rightarrow C_{12}H_{26} +) \quad 8C_2H_4$ Formula of ethene ✓ Balancing ✓	2	2 x 2.2	ALLOW any correct multiple, including fractions ALLOW $C_{16}H_{32}$ or $4C_4H_8$ for 2 marks
	(e)		Kerosene / fuel oil ✓ Idea that the supply is greater than the demand ✓	2	2 x 3.2b	ALLOW naphtha

Question			Answer	Marks	AO element	Guidance
21	(a)	(i)	Yield decreases ✓ (Lower pressure) moves position of equilibrium to the left / favours the backward reaction / ORA ✓ As there are more moles or molecules on the LHS / ORA ✓	3	2.1 2 x 1.1	ALLOW yield of CO and H ₂ increases ALLOW (equilibrium moves) to favour the reactants / to favour CO and H ₂ ALLOW equilibrium moves to increase the pressure
		(ii)	Idea that the rate of reaction is slow(er) when a lower temperature is used / ORA ✓	1	1.1	
	(b)		No effect / AW ✓	1	1.1	ALLOW a catalyst just increases the rate of reaction
	(c)		First check the answer on answer line If answer = 46.8 (tonnes) award 3 marks % yield = (actual yield ÷ predicted yield) x 100 OR 78 = (actual yield ÷ 60) x 100 ✓ actual yield = $\frac{78 \times 60}{100}$ ✓ = 46.8 (tonnes) ✓	3	1.1 2 x 2.2	ALLOW 47
	(d)	(i)	$\begin{array}{c} \text{H} \\ \\ \text{H}-\text{C}-\text{O}-\text{H} \\ \\ \text{H} \end{array}$ -O-H group correctly bonded to C ✓ Rest of structure correct ✓	2	2 x 1.1	Bond between O and H must be shown for MP1, but MP2 can still be awarded if shown as -OH

Question			Answer	Marks	AO element	Guidance
21	(d)	(ii)	-OH / OH ✓	1	1.1	ALLOW hydroxy / hydroxyl ✓ IGNORE alcohol DO NOT ALLOW hydroxide
	(e)		Potassium manganate(VII) / KMnO_4 ✓	1	1.2	ALLOW potassium permanganate / just potassium manganate ALLOW potassium dichromate(VI)
	(f)	(i)	Addition ☐ Condensation ☒ ✓ Decomposition ☐ Neutralisation ☐	1	1.1	
		(ii)	Water ✓	1	1.1	ALLOW H_2O

Question			Answer	Marks	AO element	Guidance
22	(a)		(Solution would) turn yellow / brown / orange / red ✓	1	2.2	ALLOW correct colour combinations e.g., orange-red IGNORE initial colour of solution DO NOT ALLOW a precipitate / solid / vapour DO NOT ALLOW fizzing / bubbles / effervescence
	(b)	(i)	Electrons are gained ✓	1	1.1	
		(ii)	$2\text{Br}^- - 2\text{e}^- \rightarrow \text{Br}_2$ OR $2\text{Br}^- \rightarrow \text{Br}_2 + 2\text{e}^-$ Formulae ✓ Balancing ✓	2	2 x 2.2	ALLOW any correct multiple, including fractions 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., $2\text{br}^- - 2\text{e}^- \rightarrow \text{Br}_2$
	(c)		Idea that chlorine gains electrons more easily (than bromine) / ORA ✓ (Because) incoming electron is closer to nucleus / greater attraction between nucleus and incoming electron / less shielding / ORA ✓	2	2 x 1.1	Assume unqualified answer refers to chlorine, unless clearly describing the trend in reactivity up or down Group 7 IGNORE idea that chlorine gains electrons faster or more quickly (than bromine) / ORA ALLOW chlorine has fewer (electron) shells
	(d)		52 ✓	1	2.1	

Question			Answer	Marks	AO element	Guidance
	(e)		Any two from: (Instrumental methods are) (More) sensitive ✓ (More) accurate ✓ Fast(er) / can run all the time ✓	2	2 x 1.1	ALLOW can use smaller amounts IGNORE more precise ALLOW idea that more samples can be processed in the same time or a shorter time

Question			Answer	Marks	AO element	Guidance
23	(a)		The measured volume will be greater than the actual volume. ☐ The measured volume will be smaller than the actual volume. ☒ ✓ The measured volume will be the same as the actual volume. ☐	1	3.2b	
	(b)	(i)	First check the answer on answer line If answer = 24.0 (cm³) award 1 mark Average titre = $\frac{24.1 + 23.9 + 24.0}{3}$ = 24.0 (cm³) ✓	1	2.2	ALLOW 24 (cm³) ALLOW Average titre = $\frac{24.1 + 24.0}{2} = 24.05(\text{cm}^3)$ ALLOW Average titre = $\frac{23.9 + 24.0}{2} = 23.95(\text{cm}^3)$

Question			Answer	Marks	AO element	Guidance
		(ii)	First check the answer on answer line If answer = 4.7 / 4.70 / 4.704 / 4.71 / 4.7088 (g/dm³) award 5 marks Moles of KOH = $\frac{0.100 \times 24.0}{1000} / 0.100 \times 0.024 / 0.0024$ ✓ Moles of H₂SO₄ = $\frac{0.0024}{2} / 0.0012$ ✓ Concentration of H₂SO₄ = $\frac{0.0012}{0.025} = 0.048$ (mol/dm³) ✓ M_r of H₂SO₄ = 98.0 / 98.1 ✓ Concentration of H₂SO₄ in g/dm³ = 98 x 0.048 = 4.70 (g/dm³) or Concentration of H₂SO₄ in g/dm³ = 98.1 x 0.048 = 4.71 (g/dm³) ✓ OR for MP3, 4 & 5: M_r of H₂SO₄ = 98.0 / 98.1 ✓ Mass of H₂SO₄ = 98.0 x 0.0012 = 0.1176 g or Mass of H₂SO₄ = 98.1 x 0.0012 = 0.1177 g ✓ Concentration of H₂SO₄ in g/dm³ = 0.1176 ÷ 0.025 = 4.70 (g/dm³) or Concentration of H₂SO₄ in g/dm³ = 0.1177 ÷ 0.025 = 4.71 (g/dm³) ✓	5	5 x 2.2	ALLOW ECF from average titre in part (i) ALLOW ECF from moles of KOH unit not needed ALLOW ECF from moles of alkali i.e., concentration = $\frac{\text{moles}}{0.025} / \frac{\text{moles} \times 1000}{25}$ ALLOW ECF from concentration of H₂SO₄ ALLOW ECF from moles of H₂SO₄ ALLOW ECF from mass of H₂SO₄ Answer is 4.7138 (g/dm³) if answer for (b)(i) is 24.05 cm³ or 4.6942 (g/dm³) if answer for (b)(i) is 23.95 cm³

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