Higher

GCSE

Chemisty B Twenty First Century Science

J258/02: Depth in Chemistry (Foundation Tier)

General Certificate of Secondary Education

Mark Scheme for June 2023

OCR (Oxford Cambridge and RSA) is a leading UK awarding body, providing a wide range of qualifications to meet the needs of candidates of all ages and abilities. OCR qualifications include AS/A Levels, Diplomas, GCSEs, Cambridge Nationals, Cambridge Technicals, Functional Skills, Key Skills, Entry Level qualifications, NVQs and vocational qualifications in areas such as IT, business, languages, teaching/training, administration and secretarial skills.

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.

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 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 a tick 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 questions on this paper are **3b** and **7c**

11. Annotations available in RM Assessor

Annotation	Meaning
	Correct response
	Incorrect response
	Omission mark
BOD	Benefit of doubt given
CON	Contradiction
RE	Rounding error
SF	Error in number of significant figures
ECF	Error carried forward
L1	Level 1
L2	Level 2
L3	Level 3
NBOD	Benefit of doubt not given
SEEN	Noted but no credit given
I	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
__	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.

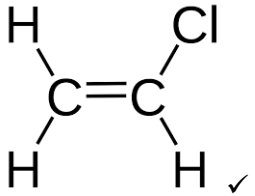
You should ensure that you have copies of these materials.

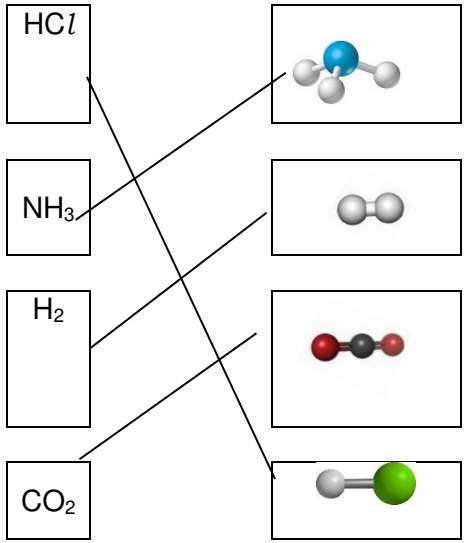
You should ensure also that you are familiar with the administrative procedures related to the marking process. These are set out in the OCR booklet **Instructions for Examiners**. If you are examining for the first time, please read carefully **Appendix 5 Introduction to Script Marking: Notes for New 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 B:

	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.

<table>
<tr><th colspan="3">Question</th><th>Answer</th><th>Marks</th><th>AO element</th><th>Guidance</th></tr>
<tr><td>1</td><td>(a)</td><td></td><td>
<table>
<tr><th></th><th>True only for an ethene monomer</th><th>True only for the repeating unit of poly(ethene)</th><th>True for both</th></tr>
<tr><td>Contains a double bond</td><td>✓</td><td></td><td></td></tr>
<tr><td>Contains a single bond</td><td></td><td></td><td>✓</td></tr>
<tr><td>Contains covalent bonds</td><td></td><td></td><td>✓</td></tr>
<tr><td>Represents a molecule with a long chain structure</td><td></td><td>✓</td><td></td></tr>
</table>
</td><td>4</td><td>1.2</td><td></td></tr>
<tr><td></td><td>(b)</td><td></td><td>  ✓</td><td>1</td><td>2.1</td><td></td></tr>
</table>

Question			Answer	Marks	AO element	Guidance
2	(a)	(i)	 ✓✓✓	3	2.1	Three or Four correct = 3 marks Two correct = 2 marks One correct = 1 mark
		(ii)	HCl ✓	1	2.1	**IGNORE** capitalisation
		(iii)	CO_2 ✓	1	2.1	**IGNORE** capitalisation / superscripts
	(b)	(i)	**First check the answer on the answer line** **If answer = 36 award 2 marks** 4 x 3 x 3 ✓ = 36 ✓	2	2.2	

<table>
<tr><th colspan="3">Question</th><th>Answer</th><th>Marks</th><th>AO element</th><th>Guidance</th></tr>
<tr><td></td><td></td><td>(ii)</td><td>
<table>
<tr><th>Description</th><th>Shown by the model</th><th>Not shown by the model</th></tr>
<tr><td>Ions in sodium chloride are arranged in a regular pattern.</td><td>✓</td><td></td></tr>
<tr><td>There are two elements in sodium chloride.</td><td>✓</td><td></td></tr>
<tr><td>The ions in sodium chloride have positive and negative charges.</td><td></td><td>✓</td></tr>
</table>
✓✓
</td><td>2</td><td>2.1</td><td>Two correct = 1 mark
Three correct = 2 marks</td></tr>
<tr><td></td><td>(c)</td><td></td><td>Shows six Na^+ ions and six Cl^- ions ✓

Arranged alternately in both directions ✓</td><td>2</td><td>2.1</td><td>ALLOW incomplete diagram with alternately arranged ions in both directions for 1 mark.
IGNORE incorrect capitalisation/charges</td></tr>
</table>

Question			Answer	Marks	AO element	Guidance
3	(a)	(i)	C_4H_{10} ✓	1	2.1	Capitals/subscripts must be correct
		(ii)	C_5H_{12} ✓	1	2.1	Capitals/subscripts must be correct
		(iii)	only contain hydrogen and carbon ✓	1	1.1	
		(iv)	cracking ✓	1	1.1	
	(b)*		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)** Describes changes related to the height of the column **AND** links ideas together. *There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.* **Level 2 (3–4 marks)** Describes changes related to the height of the column **OR** links ideas together *There is a line of reasoning presented with some structure. The information presented is relevant and supported by some evidence.* **Level 1 (1–2 marks)** States some changes shown on the diagram or identifies differences in properties. *There is an attempt at a logical structure with a line of reasoning. The information is in the most part relevant.* **0 marks** *No response or no response worthy of credit.*	6	1.1	**Demonstrates knowledge and understanding of separation of crude oil by fractional distillation** **States changes related to height of column** • column is hotter at the bottom / temperature decreases up the column • molecules increase in size/number of carbon atoms down the column • boiling points of molecules increase down the column **Links ideas together** • Molecules with higher boiling points have more carbon atoms ORA • Molecules with higher boiling points leave the column where it is hotter/higher temperature ORA • Larger molecules leave the column where it is hotter/higher temperature ORA **Identifies differences in properties (Level 1 only)** • Each fraction has a different range of boiling point • Each fraction contains a different range of carbon atoms.

Question			Answer	Marks	AO element	Guidance
4	(a)		O_2 in both equations ✓ H_2O in both equations ✓ Equation 2 balanced 2(H_2) ✓	3	1.2	Penalise O^2 or H^2O once only
	(b)		Hydrogen is not a fossil fuel / is not finite / is renewable / sustainable / Water is renewable ✓ Hydrogen produces only water / does not produce carbon dioxide / methane produces CO_2✓ Hydrogen does not cause climate change / global warming / CO_2 causes climate change / warming.✓	3	3.1b	**ALLOW** methane is non-renewable / is finite. **IGNORE** Methane is a greenhouse gas **IGNORE** methane is a fossil fuel alone (in the question)
	(c)		The flame provides activation energy for the reaction✓	1	1.1	

Question			Answer	Marks	AO element	Guidance
5	(a)	(i)	thermometer ✓ measuring cylinder / balance / scales ✓	2	2.2	**IGNORE** Beaker / Measuring tube
		(ii)	The mass of solid ✓ The volume of water ✓	2	2.2	
	(b)	(i)	Add more solid ✓ Use less water ✓	2	3.3b	
		(ii)	A and D ✓ Energy / Heat is given out ✓	2	2.2	**IGNORE** reference to temperature changes
	(c)		**First check the answer on the answer line** **If answer = 2.5(°C) award 3 marks** Calculates temperature changes for all 4 repeats ✓ Adds together and divides by 4 ✓ To give correct answer 2.5 ✓ **OR** Adds together all four start temperatures AND separately adds together all end temperatures ✓ Calculates difference and divides by 4 ✓ To give correct answer 2.5 ✓	3	2.2	**ALLOW:** 22 OR 19.5 as mean starting/ending temperature for 1 mark

<table>
<tr><th colspan="3">Question</th><th>Answer</th><th>Marks</th><th>AO element</th><th>Guidance</th></tr>
<tr><td>6</td><td>(a)</td><td></td><td>Nanoparticles are very small / may cross (blood-brain) membrane ✓
Risks are that long term effects of nanoparticles are unknown / not enough research idea ✓</td><td>2</td><td>1.1</td><td>IGNORE may enter body unless crossing membrane
IGNORE specific illnesses (e.g. cancer)</td></tr>
<tr><td></td><td>(b)</td><td></td><td><table><tr><th></th><th>True</th><th>False</th></tr><tr><td>Fullerenes are examples of nanoparticles.</td><td>✓</td><td></td></tr><tr><td>Nanoparticles are larger than atoms.</td><td>✓</td><td></td></tr><tr><td>The properties of nanoparticles are related to their very small size.</td><td>✓</td><td></td></tr><tr><td>The surface area of a nanoparticle is always equal to its volume.</td><td></td><td>✓</td></tr></table>✓✓✓</td><td>3</td><td>1.1</td><td>Four correct = 3 marks
Three correct = 2 marks
Two correct = 1 mark</td></tr>
<tr><td></td><td>(c)</td><td></td><td>C D A B ✓✓</td><td>2</td><td>2.2</td><td>largest is C and smallest is B = 1 mark
D larger than A = 1 mark
ALLOW use of diameters</td></tr>
<tr><td></td><td>(d)</td><td>(i)</td><td>First check the answer on the answer line
If answer = 9.3 (cm^3) award 2 marks

2.1(0) x 2.1(0) x 2.1(0) = 9.261(cm^3)✓

= 9.3 (to 1dp) ✓</td><td>2</td><td>

2.2

1.2</td><td></td></tr>
<tr><td></td><td></td><td>(ii)</td><td>First check the answer on the answer line
If answer = 26.46 (cm^2) award 2 marks

Shows 6 x 2.1(0) x 2.1(0) ✓
= 26.46 (cm^2)✓</td><td>2</td><td>2.2</td><td>

ALLOW 26.5</td></tr>
</table>

Question			Answer	Marks	AO element	Guidance
7	(a)		Labels gas syringe / labels measuring cylinder/burette over water ✓ no leaks in apparatus ✓	2	1.2	
	(b)	(i)	A higher temperature gives a faster (rate of) reaction ✓ Because it takes less time to collect the same volume of gas ✓	2	3.2b	**ALLOW** answers in terms of more energy / more or faster collisions
		(ii)	copper is unreactive / does not react ✓	1	2.1	**IGNORE** least reactive
		(iii)	magnesium/calcium ✓ because it is the most reactive / takes least time (to produce gas) ✓	2	3.2a	**ALLOW** other metals more reactive than zinc **ALLOW** more reactive than zinc
	(c)*		**Level 3 (5–6 marks)** Describes a method and discusses both control of variables and what to change and predicts results *There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.* **Level 2 (3–4 marks)** Describes a method and discusses control of variables **OR** Describes a method and predicts results *There is a line of reasoning presented with some structure. The information presented is relevant and supported by some evidence.* **Level 1 (1–2 marks)** Makes a statement to describe a method **OR** how to control variables **OR** expected results *There is an attempt at a logical structure with a line of reasoning. The information is in the most part relevant.* **0 marks** *No response or no response worthy of credit.*	6	3.3a	**Develops an experimental procedure to show that increased concentration increases rate.** **Suggests a method and apparatus** • add metal to acid at different concentrations and time taken to collect a (fixed volume) of gas • add metal to acid at different concentrations and measure volume of gas (in a fixed time) **Identifies what variables to control and change** • Use same temperature / volume of acid • Measure same amount of gas each time OR measure same amount of time • Repeat the experiment at different concentrations. **Predicts Results** • More concentrated acid produces more gas in a given time. • Repeats Eve's statement for single mark

Question			Answer	Marks	AO element	Guidance
						• More concentrated acid takes less time to produce same amount of gas.

Question			Answer	Marks	AO element	Guidance
8	(a)		All of the atoms in nitrogen and hydrogen are used to make ammonia.✓ The reaction makes only one product✓	2	2.1	
	(b)	(i)	eutrophication / plants/algae in rivers grow too much / oxygen in river is used up / kills (animal) life in river ✓	1	1.1	**IGNORE** specific illnesses (e.g. cancer) pollution / destroys / damages / harms habitats **IGNORE** poison
		(ii)	more crops / food can be grown / demand for food is met / people don't starve ✓	1	1.1	ALLOW "plants grow better"? "Increase the yield"?

Question			Answer	Marks	AO element	Guidance
9	(a)		**Any two from:** (in the modern model ……) (atoms) have a nucleus ORA ✓ (atoms) have electrons / have shells (of electrons) ORA ✓ (atoms) contain neutrons / protons ORA ✓ (atoms) include empty space ✓	2	1.1	**ALLOW** reverse argument for M1 M2 and M3 'IT' is the modern model **Allow (1) for** contains (sub-atomic) particles if no particles are named **IGNORE** Dalton's model shows a solid sphere alone (copied from label on diagram)
	(b)		Li/lithium ✓ Has three electrons / electron arrangement is 2.1 / first shell is full and one electron in the second shell ✓	2	2.2	Mark independently **IGNORE** atomic number/proton number of lithium is 3
	(c)	(i)	Contains one carbon (atom) and two oxygen (atoms) / contains three atoms / contains two different types of atom / contains two elements ✓	1	2.1	**DO NOT ALLOW** 'molecule' or 'ion' for 'atom' **IGNORE** has the formula CO_2 alone
		(ii)	Element idea: Dalton's formula is not an element / is a compound / contains (two) different types of atom / contains oxygen (atoms) / chlorine is an element / all atoms should be the same / chlorine contains one type of atom ✓ Number of <u>atoms</u> idea: Dalton's formula has five <u>atoms</u> / has too many <u>atoms</u> / more than 2 <u>atoms</u> / chlorine is <u>diatomic</u> / chlorine (molecules) contain two <u>atoms</u> ✓	2	2.1	NB 'It' is Dalton's formula NB 'Atoms' is needed for M2 **DO NOT ALLOW** 'molecule' or 'ion' or 'electrons' for 'atom' **DO NOT ALLOW** Dalton's formula contains 4/incorrect number of atoms **IGNORE** 'only bonds once'. **IGNORE** chlorine has the formula Cl_2 alone

Question			Answer	Marks	AO element	Guidance
	(d)		polymer molecule of oxygen atom proton electron ✓✓	2	2.1	All correct sequence= 2 marks One in wrong sequence = 1 mark **PO-MAPE**

Question			Answer	Marks	AO element	Guidance
10	(a)	(i)	Sample sweets from more than one large box / more than one packet / choose sweets randomly ✓	1	3.3a	**IGNORE** test more than one sweet / test different sweets
		(ii)	To avoid bias / to look for anomalous results/outliers / to check they are all the same / check for consistency / sample represents an overview / represents as many sweets as possible / represents a wide range ✓	1	1.2	**IGNORE** to check all sweets are safe (in the question) / some might be unsafe **IGNORE** represents ALL sweets **IGNORE** reliable / accurate / better quality data / fair test
	(b)	(i)	**First check the answer on the answer line** **If answer = 0.7 award 2 marks** shows 3.5 and 5 in working ✓ = 0.7 ✓	2	2.2	**ALLOW 2 marks** for answer= 0.66-0.74 **For (1) mark….** **ALLOW M1** for solvent front distance 5.0-5.6 and spot distance 3.3 – 4.1 **ALLOW** 1 mark for final answer 6.6-7.4 **ALLOW M2** ECF on incorrect measurement of height of spot/solvent front
		(ii)	C and D ✓ Both only give one spot / contain only one colour ✓	2	3.2a	Mark independently **IGNORE** 'do not separate'
		(iii)	B ✓ D ✓	2	3.2b	
		(iv)	The highest spot/one spot/one colour does not match any known safe colours/cannot be identified/is unknown ✓	1	3.2b	**DO NOT ALLOW** more than one spot does not match / they don't match

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