

GCSE (9–1)

Chemistry B (Twenty First Century Science)

J258/02: Depth in Chemistry (Foundation Tier)

General Certificate of Secondary Education

Mark Scheme for Autumn 2021

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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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1. 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

2. 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

3. 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.

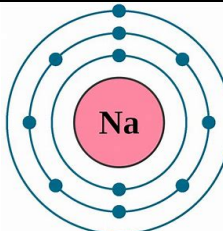
You should ensure also that you are familiar with the administrative procedures related to the marking process. These are set out in the OCR booklet **Instructions for Examiners**. If you are examining for the first time, please read carefully **Appendix 5 Introduction to Script Marking: Notes for New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

Question			Answer	Marks	AO element	Guidance
1	(a)		Air hot acid rain ✓✓	2	1.1	All three correct = (2) Two correct = (1)
	(b)	(i)	loses oxygen ✓	1	2.1	ALLOW nitrogen has gained electrons
		(ii)	oxygen is gained/reacts with urea/involved in reaction ✓	1	2.1	
		(iii)	carbon dioxide ✓ steam / water / hydrogen oxide ✓ nitrogen ✓	3	1.1	
		(iv)	All three gases/at least two named gases are not harmful to health ✓ carbon dioxide causes climate change / global warming / is a greenhouse gas ✓	2	2.1	ALLOW Water vapour is a greenhouse gas
	(c)		(yes because) Any three from: carbon (always) forms 4 bonds ✓ nitrogen (always) forms 3 bonds ✓ hydrogen (always) forms 1 bond ✓ oxygen (always) forms 2 bonds ✓	3	3.1b	

Question			Answer	Marks	AO element	Guidance																				
2	(a)	(i)	lithium chloride ✓	1	2.1																					
		(ii)	reaction is slower ✓	1	2.1																					
		(iii)	lithium is less reactive / higher in the group ✓	1	1.2	ALLOW Reverse argument																				
	(b)		<table><tr><th>Element</th><th>Group number</th><th>Solid, liquid or gas?</th><th>Colour at room temperature</th></tr><tr><td>sodium</td><td>1</td><td>solid</td><td>silver</td></tr><tr><td>chlorine</td><td>7</td><td>gas</td><td>green</td></tr><tr><td>potassium</td><td>1</td><td>solid</td><td>silver</td></tr><tr><td>iodine</td><td>17</td><td>solid</td><td>Grey/black</td></tr></table> <div><div>✓</div><div>✓</div><div>✓</div></div>	Element	Group number	Solid, liquid or gas?	Colour at room temperature	sodium	1	solid	silver	chlorine	7	gas	green	potassium	1	solid	silver	iodine	17	solid	Grey/black	3	1.1	Mark in vertical columns.
Element	Group number	Solid, liquid or gas?	Colour at room temperature																							
sodium	1	solid	silver																							
chlorine	7	gas	green																							
potassium	1	solid	silver																							
iodine	17	solid	Grey/black																							
	(c)	(i)	Shows 11 electrons ✓ In correct configuration 2.8.1 ✓	2	2.2																					
		(ii)	Seven ✓ Gain ✓	2	2.1																					

Question			Answer	Marks	AO element	Guidance
3	(a)		ions ✓ move when molten / move in liquids / do not move in solids ✓	2	1.1	
	(b)	(i)	oxygen (at positive) ✓ aluminium (at negative) ✓	2	1.1	
		(ii)	The melting point of aluminium metal is below 900°C ✓	1	2.1	
	(c)	(i)	A metal ion ✓	1	1.1	
		(ii)	(delocalised) electrons ✓ Move / movement of charge is electricity ✓	2	1.1	
	(d)	(i)	better conductor than aluminium ✓ cheaper than silver ✓	2	2.1	IGNORE references to density
		(ii)	Any one from (advantage): Cheaper ✓ less dense (than copper) ✓ Disadvantage: does not conduct electricity as well (as copper) ✓	2	2.1	

Question			Answer	Marks	AO element	Guidance
4	(a)		Choose tablets at random from each box. ✓ Choose tablets from more than one box of each brand. ✓	2	3.3a	
	(b)		A salt and water form. ✓ The acid is used up. ✓	2	1.1	
	(c)	(i)	Indicator ✓	1	3.3a	ALLOW any named acid-base indicator / litmus / phenolphthalein / methyl orange ALLOW (Universal) indicator / UI
		(ii)	To see colour change / to know when tablet is neutralised ✓	1	3.3a	ALLOW: acid is in excess / used up
		(iii)	FeelRight ✓	1	3.2b	
		(iv)	FIRST CHECK THE ANSWER ON ANSWER LINE If answer = 100.1 award 2 marks $40.1 + 12 + (16 \times 3)$ ✓ $= 100.1$ ✓	2	2.2	ALLOW 40 as Ar for Ca and therefore 100 as correct answer.
		(v)	FIRST CHECK THE ANSWER ON ANSWER LINE If answer = 500.5 award 2 marks 5.0×100.1 ✓ $= 500.5 \text{ (mg)}$ ✓	2	2.2	ALLOW ECF ALLOW 500/501 for 2 marks
	(d)	(i)	More acid needed ✓	1	3.2b	
		(ii)	because other ingredient is alkali / also reacts with acid ✓	1	3.2b	

Question		Answer	Marks	AO element	Guidance
5	(a)*	<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) Detailed explanation of similarities and differences between graphite and graphene, AND Explains a property and a use in terms of structure. <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) Explains clearly similarities and differences between properties of graphite and graphene. OR Explains clearly for a single property and links structure to the property. <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) Explains some differences between the properties of graphite and graphene. OR Explains how a property links to a structure. <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	2.1	<p>Applies knowledge and understanding to compare the properties and uses of graphite and graphene (AO2.1)</p> <ul style="list-style-type: none"> graphene is harder/stronger / graphite is weaker / flakes more easily. both allotropes/forms of carbon both conduct electricity both have high melting points both giant structures both covalent bonding graphene is more flexible / graphite is more brittle. <p>Applies knowledge and understanding to link the structure of graphite and graphene to properties and uses (AO2.1)</p> <ul style="list-style-type: none"> high melting point/ hardness/strength because of strong covalent bonds conduct electricity because of delocalised electrons graphite flakes because layers separate/ bonds between layers are weak. graphene thinnest material known because sheets of atoms are very thin / are one atom thick. graphite used in pencils because layers flake. graphene used in electrical components because it conducts electricity / is a nanoparticle so is very small.

Question			Answer	Marks	AO element	Guidance
5	(b)		diamond ✓ fullerenes ✓	2	1.1	
	(c)		Any two from: Effect on health ✓ Life span of battery ✓ Use of water in manufacture ✓ Use of energy in manufacture ✓ Cost of Transport ✓ Landfill / disposal ✓ Biodegradability ✓	2	1.1	

Question			Answer	Marks	AO element	Guidance
6	(a)		0.1 mol/dm ³ sulfuric acid ✓	1	2.2	
	(b)		(no because) sulfuric acid has a lower pH than hydrochloric acid ✓ clearly compares same concentration / compares 0.1M concentrations OR compares 0.01M concentration ✓	2	3.2a	
	(c)	(i)	Add small drop and leave colour to develop for a few seconds ✓ compares colour to chart ✓	2	1.2	
		(ii)	Ring around 3.5 in the table ✓	1	2.2	
		(iii)	idea should be below 3.0 / between 1.3 and 3.0 ✓ Should be near to 2.0 / UI gives pH of 2.0 / does not agree with UI value ✓	2	2.2	
		(iv)	(pH meter is an improvement because) pH meter gives numbers with decimal points OR Some UI values are the same / several show values of 1 / difficult to judge the colour ✓	1	2.2	ALLOW pH meter is more precise / accurate ✓

Question	Answer	Marks	AO element	Guidance
7*	<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) Describes how to adapt experimental procedure to control the acid and metal AND makes predictions about results for all three metals <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) Describes how to adapt experimental procedure to control a variable, AND makes predictions about the results <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) Basic description on how to adapt the experimental procedure OR Makes a prediction about the results. <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	4 x 2.2 2 x 3.3a	<p>Analyses information and ideas to adapt experimental procedure - 3.3a</p> <ul style="list-style-type: none"> • controls volume / amount of acid • controls concentration of acid • controls amount of metals • controls mass of metals • controls moles of metals • controls temperature • controls surface area of metals • measures time to collect 10 cm³ gas • measures amount of gas in 45 s <p>Applies knowledge and understanding to make predictions about results - 2.2</p> <ul style="list-style-type: none"> • copper does not give off any gas • calcium gives gas off more quickly than magnesium • zinc gives gas off more slowly than magnesium • calcium takes less time to give off 10cm³ than magnesium / less than 45s

Question			Answer	Marks	AO element	Guidance
8	(a)		increases ✓	1	3.1a	
	(b)	(i)	He, Ne ✓	1	3.1a	ALLOW names helium, neon
		(ii)	18 / 8 / 0 ✓	1	2.2	ALLOW noble gases / inert gases
	(c)		Potassium is the largest atom - TRUE Atomic radius gets smaller across Period 1 of the Periodic Table - TRUE As proton number increases, atomic radius always decreases - FALSE ✓✓	2	3.2b	All correct = (2) 2 correct = (1) 1 correct = 0
	(d)	(i)	FIRST CHECK THE ANSWER ON ANSWER LINE If answer = 76 (cm) award 3 marks $68/1.7 (x10^{-10}) = 40$ ✓ $40 \times 1.9 (x10^{-10})$ ✓ $= 76 (cm)$ ✓	3	2.1	Correct answer scores (3) marks ALLOW (1) only for 1.7 <u>and</u> 1.9 shown in working Note: values are (x 10 ⁻¹⁰ m) IGNORE any attempted unit conversions which cancel out
		(ii)	yellow ✓	1	1.2	IGNORE orange

Question			Answer	Marks	AO element	Guidance												
	(e)		<div>Number of protons = 11 Number of neutrons = 12 Number of electrons = 11</div> <table><tr><th>Type of particle</th><th>Charge</th><th>Relative Mass</th></tr><tr><td>proton</td><td>+1</td><td>1</td></tr><tr><td>neutron</td><td>0/neutral</td><td>1</td></tr><tr><td>electron</td><td>-1</td><td>0</td></tr></table> <div>✓✓✓</div>	Type of particle	Charge	Relative Mass	proton	+1	1	neutron	0/neutral	1	electron	-1	0	3	1.2	<div>All three numbers in first table correct and in correct places = (2)</div> <div>OR</div> <div>Two numbers correct in correct places OR 12 shown anywhere in table = (1)</div> <div>AND</div> <div>All three numbers correct and in correct places in second table = (1)</div> <div>ALLOW answers expressed as decimals e.g. 11.0 and 12.0</div>
Type of particle	Charge	Relative Mass																
proton	+1	1																
neutron	0/neutral	1																
electron	-1	0																

Question			Answer	Marks	AO element	Guidance
9	(a)	(i)	5 (minutes) ✓	1	3.1a	
		(ii)	82 (cm ³) ✓	1	3.1a	
		(iii)	FIRST CHECK THE ANSWER ON ANSWER LINE If answer = 0.273 (cm³/s) award 2 marks 5 x 60 = 300 s ✓ 82/300 = 0.273 ✓	2	1.2 3.1b	ALLOW (1) for 16.4 (no unit conversion) ALLOW 2 or more sig figs DO NOT ALLOW incorrect rounding ALLOW ECF from (a) (i) and (a) (ii)
	(b)		enzyme acts as a catalyst ✓ provides an alternative pathway/reduces activation energy ✓	2	2.1	IGNORE speeds up the reaction

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