F

GCSE (9–1)

Chemisty B (Twenty First Century Science)

J258/02: Depth in chemistry (Foundation Tier)

General Certificate of Secondary Education

Mark Scheme for June 2019

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.

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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.

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).

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

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.

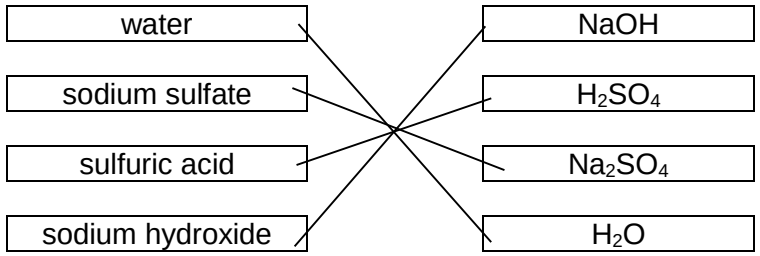
You should ensure that you have copies of these materials.

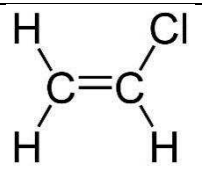
You should ensure also that you are familiar with the administrative procedures related to the marking process. These are set out in the OCR booklet **Instructions for Examiners**. If you are examining for the first time, please read carefully **Appendix 5 Introduction to Script Marking: Notes for New 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)	(i)	pH is 1.0 at the start and ~12.5 at the end / pH increases slowly up to 20cm^3 / for last 20cm^3.✓ changes suddenly when 25 cm^3 sodium hydroxide is added / when pH reaches 4 ✓	2	2.2	**IGNORE:** pH Increases (without any numbers) If no other marks scored, **ALLOW** 'pH increases' with two correct points from graph for one mark
		(ii)	(sulfuric) acid has a low pH / 1 - 6 ✓ Alkali / sodium hydroxide has a high pH / 8 - 14✓	2	1.2	**ALLOW** high concentration of H^+ ions in acid.
	(b)	(i)	2 (NaOH) 2 (H_2O) ✓	1	2.1	
		(ii)		2	1.1	All correct = 2 marks Two or three correct = 1 mark
	(c)	(i)	hydroxide (ions) ✓ H^+ ✓ H_2O ✓	2	1.1	All correct = 2 marks One or two correct = 1mark **DO NOT ALLOW:** H^2O etc.
		(ii)	Neutralisation ✓	1	1.1	

Question			Answer	Marks	AO element	Guidance
2	(a)		 ✓ CH_3✓	2	2.1	**DO NOT ALLOW:** CL FOR Cℓ
	(b)		Four single C-H bonds <u>and</u> bonds coming out from brackets ✓ Single C-C bond between C atoms ✓	2	1.2	
	(c)	(i)	**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 42 award 2 marks** Uses correct masses: (C =) 12 and (H =) 1 ✓ (12 × 3) + (1 × 6) = 42 ✓	2	2.2	
		(ii)	(11200/28) = 400 ✓	1	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>3</td><td>(a)</td><td></td><td>carbon dioxide ✓</td><td>1</td><td>1.2</td><td></td></tr>
<tr><td></td><td>(b)</td><td></td><td>
<table>
<tr><th>Substance</th><th>Raw Material</th><th>Product</th><th>Waste</th></tr>
<tr><td>copper carbonate</td><td>✓</td><td></td><td></td></tr>
<tr><td>gas X</td><td></td><td></td><td>✓</td></tr>
<tr><td>carbon</td><td>✓</td><td></td><td></td></tr>
<tr><td>water and impurities</td><td></td><td></td><td>✓</td></tr>
<tr><td>copper</td><td></td><td>✓</td><td></td></tr>
</table>
</td><td>2</td><td>1.2</td><td>All correct = 2 marks
2-4 correct = 1 mark
1 correct = 0 marks</td></tr>
<tr><td></td><td>(c)</td><td>(i)</td><td>as mass of copper carbonate increases, mass of copper increases / quotes values to show this ✓

as mass of copper carbonate doubles, mass of copper doubles / quotes values to show this ✓</td><td>2</td><td>2.2</td><td>As mass of copper carbonate doubles, mass of copper doubles = 2 marks (mark point 2 subsumes mark point 1)
ALLOW: straight line graph through the origin for 2 marks
ALLOW: mass is (about) twice the yield with data for 2 marks

IGNORE: “Increases evenly”
IGNORE: “positive correlation”</td></tr>
<tr><td></td><td></td><td>(ii)</td><td>If no copper carbonate is used, no copper is made ✓</td><td>1</td><td>2.2</td><td>DO NOT ALLOW: reverse argument</td></tr>
<tr><td></td><td></td><td>(iii)</td><td>29.0 (g) ✓</td><td>1</td><td>2.2</td><td>ALLOW 28-30 inclusive (± ½ square)</td></tr>
<tr><td></td><td></td><td>(iv)</td><td>She did not dry the copper at the end. ✓

Her copper contains solid impurities. ✓</td><td>2</td><td>3.3b</td><td></td></tr>
<tr><td></td><td>(d)</td><td></td><td>Nina is correct because she has made 18.0 g of copper (compared to 4.8 g) / 13.2 g more ✓

Kai is correct linked to reason: 96 % compared to 69 % / Kai’s actual yield is closer to his theoretical yield. ✓</td><td>2</td><td>3.2a</td><td></td></tr>
</table>

Question			Answer	Marks	AO element	Guidance
4	(a)		(aq) for KI and KCl ✓	1	2.1	
	(b)		chlorine + potassium iodide → iodine and potassium chloride✓	1	2.1	
	(c)		iodine (in solution) is brown / identifies iodine ✓	1	1.2	
	(d)		exothermic ✓ more ✓ displacement ✓ salt ✓	3	2.2 1.1 1.1	All four correct = 3 marks three correct = 2 marks two correct = 1 marks one correct = 0 marks

Question			Answer	Marks	AO element	Guidance
5	(a)		**<** ✓ **~** ✓ **>** ✓	**2**	**2.1**	All three correct = 2 marks 2 or 1 correct = 1 mark **ALLOW:** '>' for second statement
	(b)	**(i)**	liquid ✓	**1**	**2.1**	
		(ii)	room temperature / 20ºC is above melting point / -39ºC✓ room temperature / 20ºC is below boiling point / 357ºC✓	**2**	**2.1**	**ALLOW:** 1 mark only for 'it has already melted' **ALLOW**: Room temperature is between melting and boiling point for 2 marks
	(c)		Transition metals are good catalysts✓ Zinc does not form coloured compounds. ✓	**2**	**1.1**	

Question			Answer	Marks	AO element	Guidance
6	(a)		reaction is exothermic ✓ gives out heat ✓	2	2.1	
	(b)		**Any two from:** ammonium sulfate powder / dry / solid is made ✓ other process(es) make (ammonium sulfate) <u>solution</u> ✓ fertiliser needs to be a solid to be sold ✓	2	2.1	
	(c)		**Any two from:** both processes 1 and 2 have higher atom economies than process 3 ✓ in processes 1 and/or 2 all the atoms are used (to make the product) / only the product is made ✓ process 3 has a waste product / makes $CaCO_3$ as well / has a different equation ✓	2	2.1	**IGNORE:** Processes 1 & 2 have 100% atom economy.
	(d)	(i)	filtration ✓ evaporation ✓	2	2.2	
		(i)	batch is small scale / does reaction in a container / idea of complete reaction finishing / fixed amount ✓ continuous goes on all the time / idea that reactants keep being added and products keep being removed ✓	2	1.1	

Question			Answer	Marks	AO element	Guidance
7*			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)** Uses ideas about particles to make a statement about what happens when solids melt **AND** why heating causes melting **AND** why the melting points are different. 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)** Uses ideas about particles to make statements about either what happens when solids melt **OR** why heating causes melting **OR** why the melting points are different. 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)** Uses ideas about particles to make a correct statement about the diagrams. 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**	**3x 2.1.** **3x 3.1a**	**AO2.1/AO3.1a Application of knowledge and interpretation of data and diagrams in question uses the model to explain what happens when solids melt:** • particles gain energy • particles move more/move faster (**IGNORE** 'move apart' 'spread out') • particles move over each other • particles leave their regular arrangement **AO2.1/AO3.1a Application of knowledge and interpretation of data and diagrams in question Uses the model to explain why heating causes melting:** • forces between particles in solid are broken / overcome • heating breaks bonds **AO2.1/AO3.1a Application of knowledge and interpretation of data and diagrams in question Uses the model to explain why ice and salt have different melting points:** • forces between water molecules are weaker (than the forces between particles in sodium chloride/salt) ORA • ice has weaker (intermolecular) bonds than salt • sodium chloride/salt is an ionic solid (with strong bonds) • water / ice is a covalent compound (with weak forces between molecules). **IGNORE** 'water has weaker bonds than salt'.

<table>
<tr><th colspan="3">Question</th><th>Answer</th><th>Marks</th><th>AO element</th><th>Guidance</th></tr>
<tr><td>8</td><td>(a)</td><td>(i)</td><td>FIRST CHECK THE ANSWER ON ANSWER LINE
If answer = 400 000 (ppb) award 2 marks

0.04 x 10 000 000 ✓

= 400 000 (ppb) ✓</td><td>2</td><td>2x2.2</td><td></td></tr>
<tr><td></td><td></td><td>(ii)</td><td>concentration/amount of carbon dioxide is much higher than methane and nitrous oxides / figures to show this ✓

(so will make a) bigger difference to climate change /
(reducing will have) more impact on global temperatures ✓</td><td>2</td><td>2x3.2a</td><td>IGNORE: ‘bigger effect (on environment’).</td></tr>
<tr><td></td><td>(b)</td><td>(i)</td><td>
<table>
<tr><th>Statement</th><th>True (✓)</th><th>False (✓)</th></tr>
<tr><td>For each gas the concentration remained approximately constant for 1500 years.</td><td>✓</td><td></td></tr>
<tr><td>The concentration of methane is usually higher than the concentration of nitrous oxides.</td><td>✓</td><td></td></tr>
<tr><td>The concentration of carbon dioxide is measured in ppb.</td><td></td><td>✓</td></tr>
<tr><td>The concentration of all three gases has more than doubled since 1500 years ago.</td><td></td><td>✓</td></tr>
</table>
</td><td>3</td><td>3 x 3.1a</td><td>All four correct = 3 marks
three correct = 2 marks
two or one correct = 1 mark</td></tr>
<tr><td></td><td></td><td>(ii)</td><td>(yes)
overall pattern is the same / all three gases maintain (low) levels (for a long time) / all three have increased sharply (since ~1800)✓

small up and down variations do not follow same pattern ✓</td><td>2</td><td>2x3.1b</td><td>If “No” is ticked but a correct explanation is given, award 1 mark.</td></tr>
</table>

Question			Answer	Marks	AO element	Guidance
9*			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 experimental procedure, including safety. **AND** Gives some expected observations. **AND** Gives difference in reactivity for all three metals. 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 experimental procedure, including safety. **AND** Gives some expected observations. **OR** Describes experimental procedure, including safety. **AND** Gives difference in reactivity for all three metals. 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 experimental procedure or safety precautions. **OR** Gives observations. **OR** Gives difference in reactivity for at least two metals. 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**	**1x1.1** **3x 1.2** **2 x 3.3a**	**AO3.3a Analyse information and ideas to develop experimental procedures** • (safety) holds metal in tongs / stays behind safety screen • adds (small pieces of) metal to water **AO1.2 knowledge and understanding of scientific techniques and procedures to give expected observations** • metals fizz • metals move around on water • (some) metals show flame/sparks/alight • heat is given off/water gets hot • metal 'disappears'/ 'dissolves' / is used up • all reactions are fast **AO1.1 Knowledge and understanding of difference in reactivity's** • order of reactivity is potassium – sodium – lithium / more reactive lower down group 1

Question			Answer	Marks	AO element	Guidance
10	(a)		**Any three from:** more than one metal ion has green colour / orange colour / same colour ✓ A/green flame colour could be copper or zinc or iron ✓ B/orange-red flame colour is (probably) calcium / could be calcium or iron ✓ Iron can be many different colours (so difficult to identify) ✓ Difficult to tell the difference between some colours (by eye) / colours overlap ✓	3	2.2	**ALLOW** two metals linked to a colour/ two metals linked to A or B **IGNORE** it could be a mixture **IGNORE** not all ions are given for reference
	(b)	(i)	gives a result with acid and with silver nitrate / could be a carbonate or a chloride ✓	1	2.2	Result for carbonate is fizzes/CO_2 given off/limewater turns milky and silver nitrate result is white precipitate **ALLOW** correct formulae for ions e.g. CO_3^{2-} / Cl^- **IGNORE** 'halide' **DO NOT ALLOW** chlorine
		(ii)	A: copper and B calcium (no iron or zinc) ✓ chloride in both ✓ A (only) carbonate ✓	3	3.2b	**DO NOT ALLOW** chlorine **DO NOT ALLOW** carbonate mark if additional incorrect anions if more than 2 for A or 1 for B are given

	(c)		faster / gives a printout / distinct or matching lines / idea that spectrum is unique / does not rely on human eye / does not rely on observations / less (human) error / can identify a mixture of ions / more sensitive / does not rely on human judgment (of colour) ✓	**1**	**1.2**	**IGNORE** it is easier/more accurate/more reliable **ALLOW** gives amounts

Question			Answer	Marks	AO element	Guidance
11	(a)	(i)	volume = 8 ✓ surface area = 48 ✓ ratio = (48 ÷ 8) = 6 ✓	3	2.2	**ALLOW** ECF
		(ii)	nanoparticles have a higher surface area ✓ when the same volume is compared ✓	2	1.1	**ALLOW** 1 mark for 'They have a bigger surface area to volume ratio' **IGNORE** 'they are smaller'
	(b)	(i)	Nanoparticles are (very/much) small(er) ✓ Nanoparticles are smaller than holes / can <u>fit</u> through / metal particles are <u>too large</u> to pass through the holes ✓	2	1.1 2.1	**IGNORE** 'can go through holes'
		(ii)	**Any three from:** Some risks of nanoparticles are not known ✓ Risk is the same for both / (Risk is different because) socks use nanoparticles outside the body, cancer treatment they are inside ✓ Cancer is life threatening / can cause death / very serious disease ✓ Benefit for treating cancer greater / treating cancer is worth the risk / benefit outweighs risk✓ Not having smelly feet is not important / not worth the risk / benefit does not outweigh risk ✓	3	3.1b	

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