

GCSE (9–1)

Combined Science (Chemistry) A (Gateway Science)

J250/09: Paper 9 (Higher Tier)

General Certificate of Secondary Education

Mark Scheme for November 2020

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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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Annotations

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 Combined Science A:

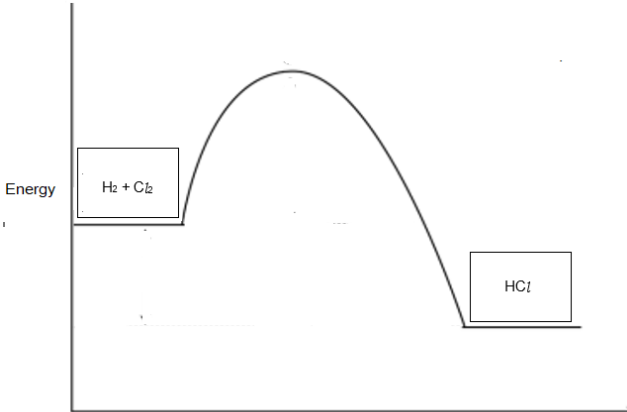
	Assessment Objective
AO1	Demonstrate knowledge and understanding of scientific ideas and scientific techniques and procedures.
AO1.1	Demonstrate knowledge and understanding of scientific ideas.
AO1.2	Demonstrate knowledge and understanding of scientific techniques and procedures.
AO2	Apply knowledge 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.

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			A ✓	1	2.2	
2			B ✓	1	2.1	
3			A ✓	1	1.1	
4			A ✓	1	1.1	
5			D ✓	1	1.1	
6			B ✓	1	1.1	
7			B ✓	1	2.2	
8			D ✓	1	1.1	
9			A ✓	1	2.2	
10			B ✓	1	2.2	

Question			Answer	Marks	AO element	Guidance
11	(a)		<u>Formulation</u> ✓	1	1.1	
	(b)		FIRST CHECK ANSWER ON ANSWER LINE If answer = 4.75 (g) award 2 marks % of water = $(100 - 5.2 - 74.8 - 0.5 - 0.5) = 19(\%)$ ✓ mass of water = $\frac{25 \times 19}{100} = 4.75$ (g) ✓	2	2 x 2.2	ALLOW 4.8 ECF from incorrect % of water
	(c)	(i)	Idea that its boiling point is (very) low / requires (very) little energy to evaporate ✓	1	3.2b	ALLOW idea that intermolecular forces /forces between molecules are weak / require little energy to break
		(ii)	Idea that energy is required (for the alcohol to evaporate) ✓ Idea that energy is supplied by / absorbed from the skin ✓	2	2 x 3.2b	ALLOW 'body' for skin

Question			Answer	Marks	AO element	Guidance
12	(a)		Mg(OH) ₂ ✓	1	2.1	
	(b)		MgCO ₃ + 2HCl → MgCl ₂ + CO ₂ + H ₂ O Formulae ✓ Balancing ✓	2	1 x 1.1 1 x 2.2	ALLOW any correct multiple, including fractions ALLOW = / ⇌ instead of → 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 IGNORE state symbols
	(c)	(i)	FIRST CHECK ANSWER ON ANSWER LINE If answer = 79.9 award 2 marks 184.1 – 24.3 = 159.8 ✓ 159.8 ÷ 2 = 79.9 ✓	2	2 x 2.2	ALLOW ECF from incorrect subtraction
		(ii)	Bromine/Br ✓	1	3.2b	ECF from 12(c)(i) if element correctly matched to an incorrect A _r in group 7

Question			Answer	Marks	AO element	Guidance												
13	(a)		<div><p>Energy</p><p>Progress of reaction</p><p>$\text{H}_2 + \text{Cl}_2$ ✓</p><p>HCl ✓</p></div>	2	2 x 1.1	<p>ALLOW words instead of symbols and if no other mark is scored allow 'reactants' in the left hand box and 'products' in the right hand box for 1 mark State symbols and balancing not required for mark</p>												
	(b)		<table><tr><td></td><td>A</td><td>B</td><td>C</td></tr><tr><td>Energy released 102 kJ/mol</td><td></td><td></td><td>✓</td></tr><tr><td>Activation energy 142 kJ/mol</td><td>✓</td><td></td><td></td></tr></table> <p>✓ ✓</p>		A	B	C	Energy released 102 kJ/mol			✓	Activation energy 142 kJ/mol	✓			2	2 x 3.1a	
	A	B	C															
Energy released 102 kJ/mol			✓															
Activation energy 142 kJ/mol	✓																	

Question			Answer	Marks	AO element	Guidance
14	(a)		Base ✓	1	1.1	IGNORE alkali
	(b)		Wear gloves/goggles ✓	1	1.2	
	(c)		Idea that it ensures all hydrochloric acid has reacted ✓	1	2.2	ALLOW idea it produces maximum mass of salt
	(d)	(i)	FIRST CHECK ANSWER ON ANSWER LINE If answer = $0.00629/6.29 \times 10^{-3}$ (mol) award 3 marks M_r of CuO = $(63.5 + 16.0) = 79.5$ ✓ moles CuO = $0.50 \div 79.5 = 0.006289/6.289 \times 10^{-3}$ ✓ = $0.00629/6.29 \times 10^{-3}$ (mol) ✓	3	3 x 2.2	 ALLOW ECF from M_r of CuO if first mark not awarded ALLOW ECF from incorrect calculation for 3 sig fig mark
		(ii)	2.50×10^{-3} mol HCl reacts with 1.25×10^{-3} mol CuO ✓ $0.00629/6.29 \times 10^{-3}$ mol is larger than 1.25×10^{-3} mol ✓	2	2 x 2.2	ALLOW reacting ratio of 2:1 ORA ALLOW 1 mark for idea that the calculated number of moles of CuO added is greater than the number of moles of CuO needed to neutralise the HCl, if no other mark awarded
	(e)	(i)	Idea that <u>excess/unreacted</u> copper oxide still present at end of stage 1 ✓	1	3.2b	
		(ii)	Filter to remove this copper oxide (before stage 2) ✓	1	3.3b	

Question	Answer	Marks	AO element	Guidance
15*	<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) Candidate supports the student's analysis of the conclusion AND applies detailed knowledge and understanding of structure and bonding to justify student's conclusion for both X/diamond and Y/chlorine.</p> <p><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) Candidate supports the student's analysis of the conclusion AND Applies some knowledge and understanding of structure and bonding to justify student's conclusion for EITHER X/diamond OR Y/chlorine.</p> <p><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) Candidate supports the student's analysis of the conclusion OR Applies some knowledge and understanding of EITHER structure OR bonding to justify student's conclusion for EITHER X/diamond OR Y/chlorine.</p>	6	2 x 1.1 1 x 3.2b 3 x 2.1	<p>AO1.1 Demonstrates knowledge and understanding of the structure and bonding in covalent compounds</p> <ul style="list-style-type: none"> Simple covalent compounds, eg Y/chlorine, have low melting points Giant covalent molecules / macromolecules, eg X/diamond, have high boiling points <p>AO3.2b Analyses information to evaluate information about X and Y</p> <ul style="list-style-type: none"> Student is correct / X is diamond and Y is chlorine <p>AO2.1 Applies knowledge and understanding to explain why X/diamond has a much higher melting point than Y/chlorine</p> <p>X/Diamond:</p> <ul style="list-style-type: none"> every carbon atom bonded to four other carbon atoms large amounts of energy needed to break many strong covalent bonds <p>Y/Chlorine:</p> <ul style="list-style-type: none"> (covalent bonding between atoms but) weak intermolecular forces between molecules more energy required to break covalent bonds in diamond than required to break intermolecular forces in chlorine / ORA covalent bonds in diamond stronger than intermolecular forces in chlorine / ORA

Question			Answer	Marks	AO element	Guidance
			<p><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>			<p>Any description of ionic bonding contradicts and so limits the response to level 2</p>

Question			Answer	Marks	AO element	Guidance
16	(a)		(Phosphoric acid) is fully ionised or completely dissociated (in aqueous solution) ✓	1	1.1	ALLOW all molecules release H ⁺ ions ALLOW $\text{H}_3\text{PO}_4 \rightarrow 3\text{H}^+ + \text{PO}_4^{3-}$ DO NOT ALLOW strong acids have many H ⁺ ions / strong acids have a high concentration of H ⁺ ions IGNORE strong acids are more ionised / dissociated than weak acids
	(b)		Idea that the solution contains a low ratio of hydrogen ions / acid to the volume of solution ✓	1	1.1	
	(c)		$2\text{H}_3\text{PO}_4 + 3\text{Ca}(\text{OH})_2 \rightarrow \text{Ca}_3(\text{PO}_4)_2 + 6\text{H}_2\text{O}$ ✓✓ 1 mark for correct balancing of $2\text{H}_3\text{PO}_4 + 3\text{Ca}(\text{OH})_2$ 1 mark for correct balancing of $6\text{H}_2\text{O}$	2	2 x 2.2	ALLOW correct multiples e.g. $4\text{H}_3\text{PO}_4 + 6\text{Ca}(\text{OH})_2 \rightarrow 2\text{Ca}_3(\text{PO}_4)_2 + 12\text{H}_2\text{O}$
	(d)		pH increases by a factor of 1, (as the hydrogen ion concentration decreases by a factor of 10) ✓ pH increases from 0.50 to 1.50, hydrogen ion concentration decreases from 0.32 to 0.032 / pH increases from 1.00 to 2.00, hydrogen ion concentration decreases from 0.10 to 0.01 ✓	2	2 x 3.2b	ORA for both points
	(e)		$\text{H}^+(\text{aq}) + \text{OH}^-(\text{aq}) \rightarrow \text{H}_2\text{O}(\text{l})$ Equation ✓ State symbols ✓	2	2 x 1.1	ALLOW any correct multiple, including fractions ALLOW = / \rightleftharpoons instead of \rightarrow DO NOT ALLOW and / & instead of '+' Mark for state symbols is dependent on correct species

Question			Answer	Marks	AO element	Guidance
17	(a)		Idea of splitting up a chemical compound (into its elements) ✓ using an electric current/electricity ✓	2	2 x 1.2	
	(b)		Cations are positive and anions are negative ✓	1	1 x 1.1	
	(c)	(i)	$K^+ + e^- \rightarrow K$ ✓	1	1 x 2.2	ALLOW $K^+ \rightarrow K - e^-$
		(ii)	reduction ✓ (because it) involves the gain of electrons ✓	2	2 x 1.1	Second mark is dependent on first mark
	(d)		Hydrogen ✓ Potassium is more reactive than hydrogen / hydrogen ions are discharged more readily than potassium ions ✓	2	1 x 2.1 1 x 1.1	ALLOW Reverse argument
	(e)		Chlorine ✓ Chloride ions are discharged more readily than hydroxide ions ✓	2	1 x 2.1 1 x 1.1	ALLOW Reverse argument

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