

GCSE (9–1)

Combined Science (Chemistry) A (Gateway Science)

J250/03: Paper 3 (Foundation 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			B ✓	1	1.2	
2			B ✓	1	1.1	
3			A ✓	1	1.1	
4			B ✓	1	1.1	
5			D ✓	1	2.1	
6			B ✓	1	1.1	
7			A ✓	1	2.1	
8			C ✓	1	2.1	
9			A ✓	1	2.2	
10			B ✓	1	2.2	

Question			Answer	Marks	AO element	Guidance
11	(a)		$1.6 \times 10^{-15} \text{ m}$ ☐ $1.6 \times 10^{-10} \text{ m}$ ☒ $1.6 \times 10^{-5} \text{ m}$ ☐	1	1.1	
	(b)		Idea that Group 2 as it has 2 electrons in its <u>outer</u> (electron) shell ✓ Idea that Period 3 as it has 3 (electron) shells ✓	2	2 x 2.1	DO NOT ALLOW outside shell ALLOW for 1 mark: it has 2 electrons in the outer shell AND it has 3 (electron) shells
	(c)	(i)	$2\text{Mg} + \text{O}_2 \rightarrow 2\text{MgO}$ ✓✓	2	2 x 2.2	1 mark for each correct number. ALLOW any correct multiples e.g. $4\text{Mg} + 2\text{O}_2 \rightarrow 4\text{MgO}$
		(ii)	Magnesium loses electrons ✓ Magnesium loses <u>two</u> electrons ✓	2	2 x 1.1	Idea that magnesium lose electrons scores 1 mark Idea that magnesium loses <u>two</u> electrons scores both marks If an incorrect ion is given e.g. Mg^{2-} this CONs one mark
	(d)	(i)	Idea that both have the same number of protons / same atomic number ✓ but different numbers of neutrons / different mass number ✓	2	2 x 1.1	IGNORE reference to numbers of electrons ALLOW they both have 12 protons ALLOW idea that one of them has an extra neutron IGNORE Relative Atomic Mass (or RAM) if used for Mass Number

Question			Answer	Marks	AO element	Guidance												
		(ii)	<table><tr><th>Isotope</th><th>Number of protons</th><th>Number of neutrons</th><td></td></tr><tr><td>$^{24}_{12}\text{Mg}$</td><td>12</td><td>12</td><td>✓</td></tr><tr><td>$^{25}_{12}\text{Mg}$</td><td>12</td><td>13</td><td>✓</td></tr></table>	Isotope	Number of protons	Number of neutrons		$^{24}_{12}\text{Mg}$	12	12	✓	$^{25}_{12}\text{Mg}$	12	13	✓	2	2 x 2.2	Mark by row <
Isotope	Number of protons	Number of neutrons																
$^{24}_{12}\text{Mg}$	12	12	✓															
$^{25}_{12}\text{Mg}$	12	13	✓															

Question			Answer	Marks	AO element	Guidance
12	(a)		Measuring cylinder ✓	1	3.3a	ALLOW burette/pipette
	(b)		18 (°C) ✓	1	1.1	
	(c)	(i)	Measure the temperature after the magnesium has reacted / at the end (of the experiment) ✓	1	3.3b	ALLOW ideas based upon obtaining a temperature change ALLOW measure temperature after magnesium has been added
		(ii)	any temperature greater than 18 (°C) ✓	1	1.2	ALLOW ECF from 12(b) i.e. temperature greater than that given in 12(b) ALLOW the temperature will increase / rise
	(d)		Some heat escaped from the top of the polystyrene cup ☒ The thermometer was left in the hydrochloric acid for too long ☐ Too much magnesium was added to the hydrochloric acid ☐	1	3.2a	
	(e)	(i)	Idea that products are of a lower <u>energy</u> than the reactants OR / <u>energy</u> is given out ✓	1	1.1	IGNORE heat is given out
		(ii)	(Minimum amount of) energy needed for a reaction to start ✓	1	1.1	ALLOW energy needed for a reaction
	(f)	(i)	Hydrogen ✓	1	1 x 1.1	ALLOW H ₂ IGNORE H on its own
		(ii)	Use a lighted spill / splint ✓ goes 'pop' / squeaky pop ✓	2	2 x 1.2	ALLOW put it in a flame

Question			Answer	Marks	AO element	Guidance
13	(a)		chromatography ✓	1	1.2	
	(b)	(i)	Water ✓	2	2.2	
		(ii)	Idea that the black ink /colours / dyes (in the black ink) are soluble (in water) ✓		2.2	
	(c)		Yes as the (R_f) value (0.46) is close to that given in the table (0.49) ✓ OR No as the (R_f) value (0.46) is different to that given in the table (0.49) ✓	1	3.1b	Mark is for the decision (yes or no) AND the correct matching reason
	(d)		FIRST CHECK ANSWER ON ANSWER LINE If answer = 0.40 award 3 marks $R_f = \frac{\text{distance travelled by the ink / spot}}{\text{distance travelled by the solvent}}$ OR $21 \div 53$ ✓ = 0.3962 OR 0.396 ✓ = 0.40 ✓ (2 sig figs)	3	1 x 1.2 2 x 2.2	IGNORE any units given ALLOW 2 marks for 0.396 up to calculator value of 0.3962264150943 ALLOW ECF if a calculation using both pieces of data together has given an incorrect value but expressed as 2SF (for 1 mark) 0.4 scores 2 marks only

Question	Answer	Marks	AO element	Guidance
14*	<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) Analyses the information to identify the type of bonding present in Y AND Z AND Explains their decision in detail using some ideas about structure and bonding for both Y AND Z.</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) Analyses the information to identify the type of bonding present in Y AND Z AND Either provides some evidence OR a partial explanation for their decision using ideas about structure and bonding</p> <p><u>OR</u></p> <p>Analyses the information to identify the type of bonding present in Y OR Z AND Explains their decision using ideas about structure and bonding for Y OR Z</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>	6	2 x 2.1 2 x 3.1a 2 x 3.2b	<p>AO3.2b Analyses information to draw conclusions about the bonding in Y and Z</p> <ul style="list-style-type: none"> Y is an ionic compound Z is a (simple) covalent compound <p>AO3.1a Analyses information to interpret the type of bonding in Y and Z</p> <ul style="list-style-type: none"> Y is ionically bonded because it has a high melting/boiling point Y is ionically bonded because only conducts electricity as a molten liquid but not as a solid Z is covalently bonded because it has a low melting/boiling point Z is covalently bonded because it does not conduct electricity <p>AO2.1 Applies knowledge and understanding to explain information about Y and Z</p> <ul style="list-style-type: none"> Y has a high melting point as forces of attraction (between ions) are strong / require large amount of energy to break Y conducts electricity as a molten liquid because the ions are free to move (and carry the current) Z has a low melting / boiling point as the intermolecular forces are weak / intermolecular forces require little energy to break Z does not conduct electricity as its molecules are not charged

Question			Answer	Marks	AO element	Guidance
			<p>Level 1 (1–2 marks)</p> <p>Analyses the information to identify the bonding in Y AND Z</p> <p><u>OR</u></p> <p>Analyses the information to identify the bonding in Y OR Z with some evidence</p> <p><u>OR</u></p> <p>Explains a piece of evidence using ideas about structure and bonding</p> <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</p> <p><i>No response or no response worthy of credit.</i></p>			

Question			Answer	Marks	AO element	Guidance
15			<p>Any four from: (Periodic Table on data sheet is)</p> <p>ordered in atomic number (not mass number) ✓</p> <p>doesn't leave gaps for missing elements ✓</p> <p>contains more/all currently known elements ✓</p> <p>doesn't have two or more elements in same box ✓</p> <p>has all elements in correct groups / elements now in groups based on similar properties ✓</p> <p>separates out the Transition metals ✓</p> <p>contains Group 0 (elements) ✓</p>	4	4 x 1.1	<p>ALLOW ORA based upon Mendeleev's Periodic Table</p> <p>ALLOW The elements are all filled in</p> <p>ALLOW the idea that elements eg Cu/Zn/Ti/V/Cr/Mn/Fe/Co/Ni are transition elements, but in Mendeleev's table have been put in another group</p> <p>ALLOW shows atomic number / number of protons / relative atomic mass/ names of elements IGNORE Mass number</p>

Question			Answer	Marks	AO element	Guidance
16	(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
17	(a)		$\text{Mg}(\text{OH})_2$ ✓	1	2.1	
	(b)		$\text{MgCO}_3 + 2\text{HCl} \rightarrow \text{MgCl}_2 + \text{CO}_2 + \text{H}_2\text{O}$ Formulae ✓ Balancing ✓	2	1 x 1.1 1 x 2.2	ALLOW any correct multiple, including fractions ALLOW = / $\rightleftharpoons$ instead of $\rightarrow$ 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 $184.1 - 24.3 = 159.8$ ✓ $159.8 \div 2 = 79.9$ ✓	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

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