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H

GCSE (9–1)

Combined Science B (Twenty First Century Science)

J260/06: Chemistry (Higher 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
__	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 Combined Science 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.

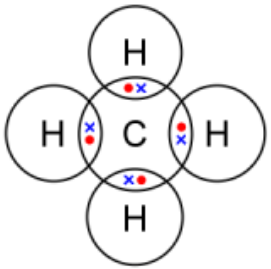
Question			Answer	Marks	AO element	Guidance
1	(a)	(i)	27(%) ✓	1	2.1	
		(ii)	(particles) slower ✓ (particles) closer together ✓ becomes liquid/condensed ✓	3	1.1	**ALLOW** forms clouds/rain
	(b)		carbon dioxide decreases **AND** oxygen increases ✓ plants formed which absorb carbon dioxide ✓ for photosynthesis, and emit oxygen ✓	3	3.2b 1.1 x 2	**ALLOW** carbon dioxide dissolved in the oceans
	(c)	(i)	4 **AND** 3 ✓	1	2.1	
		(ii)	No oxygen ✓	1	2.1	

Question			Answer	Marks	AO element	Guidance
2	(a)		nanoparticles bigger than (all the) atoms/ORA ✓ nanoparticles bigger than water molecules/ORA ✓ nanoparticles smaller than/not larger than polymer molecules/ORA ✓	3	3.1b	
	(b)	(i)	(nanoparticles) because largest surface area to volume ratio ✓	1	2.1	**DO NOT ALLOW** answers that simply quote the values from the table, needs to be a comparative statement.
		(ii)	(no) Not proportional/use of word proportional ✓ As size increases particles have smaller surface area to volume ratios ✓	2	3.1a	
	(c)		atoms arranged in balls – carry medicines into the body atoms arranged in tubes – molecular sieves high surface area to volume ratio – catalysts ✓✓	2	1.1	3 correct = 2 marks 2 or 1 correct = 1 mark
	(d)		Catalysts decrease the activation energy of the reaction ✓ Catalysts reduce the energy needed to break the bonds in the reactants ✓	2	1.1	

Question			Answer	Marks	AO element	Guidance
3	(a)	(i)	idea that elements in a group have similar properties / properties of elements in a group 'fitted'.✓	1	1.1	
		(ii)	more elements were discovered ✓ properties matched predicted properties / matched other elements in the same group ✓	2	1.1	
		(iii)	in reverse order of atomic mass✓	1	3.1a	
	(b)	(i)	atomic number - total number of electrons / 3 electrons✓ group - number of electrons in outer shell / Group 1 because 1 electron in outer shell ✓ period - number of electron shells / period 2 because 2 electron shells✓	3	1.1	
		(ii)	How - Metals form positive ions AND non-metals form negative ions ✓ Why - metals small number of electrons in outer shell AND non-metals large number in outer shell ✓ metals lose electrons to form ions AND non-metals gain electrons to form ions ✓	3	1.1	**ALLOW** reference to lithium and fluorine in place of metal and non-metal **ALLOW** diagram showing positive and negative ions

Question			Answer	Marks	AO element	Guidance
4	(a)	(i)	particles move faster/have more kinetic energy ✓ more have activation energy/more successful collisions ✓	2	1.1	
		(ii)	**Any two from:** increase concentration of acid smaller pieces of zinc / bigger surface area of zinc add a catalyst ✓	1	3.3b	
	(b)	(i)	4.5 (min) ✓	1	2.2	
		(ii)	94 (cm^3) ✓	1	2.2	
		(iii)	**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 0.348 (cm^3/s) award 2 marks** 4.5 x 60 = 270 (s) ✓ 94 ÷ 270 = 0.348 (cm^3/s) ✓	2	 1.2 2.2	**ALLOW ECF** from (i) and (ii)
		(iv)	**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 2.56 to 4.17 (cm^3/s) award 3 marks** tangent drawn at 0 <u>and</u> readings for x and y axis ✓ time value converted into seconds ✓ calculation of rate using readings from graph ✓	3	 2.2 1.2 2.2	
		(v)	Rate gets lower ✓ Concentration of acid decreases ✓	2	2.2	

Question			Answer	Marks	AO element	Guidance
5	(a)		heat/energy/radiation trapped in ✓ **AND any two from:** UV from sun absorbed by earth ✓ Carbon dioxide absorbs IR which is emitted from earth ✓ Re-emits irradiation in all directions (including back to Earth) ✓	3	1.1	
	(b)	(i)	(l) ✓ (aq) and (aq) ✓	2	1.1	
		(ii)	reversible ✓	1	1.1	**ALLOW** can go back and form between reactants and products/description of a reversible reaction
		(iii)	pH goes down ✓ increase in concentration of H^+ / more H^+ ions ✓	2	2.1	**ALLOW** becomes more acidic for 1 mark if no other marks scored
		(iv)	use pH meter ✓ use Universal Indicator ✓	2	3.3a	

Question			Answer	Marks	AO element	Guidance
6	(a)	(i)	 ✓	1	2.2	Symbols and electrons both required.
		(ii)	Both covalent ✓ Diamond giant (molecular) **AND** methane simple (molecular) ✓	2	2.1	
		(iii)	Diamond many strong bonds / strong bonds in all directions ✓ Methane weak bonds between the molecules ✓ More energy to break bonds in diamond ORA ✓	3	2.1	
	(b)	(i)	All electrons used in bonding for diamond ✓ Delocalised electrons (between layers) for graphite ✓	2	1.1	
		(ii)	Diamond atoms held in fixed positions ✓ Graphite layers can slide / weaker bonds between layers ✓	2	1.1	**ALLOW** 1 mark for idea that only graphite has layers if no other mark scored.

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)** **Describes experimental method using the given solutions AND describes observations in detail AND links observations to trend in reactivity** *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 suitable experimental method AND describes some observations** **OR** **Describes a suitable experimental method AND gives trend in reactivity** *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)** **Describes a suitable experimental method OR gives trend in reactivity** *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**	**4 x 1.2** **2 x 2.2**	**AO1.2 Description of experimental method** • mixes each halogen solution with each halide solution • idea of apparatus e.g. test tube • any suitable method that would show a trend in reactivity **AO1.2 Description of observations** • chlorine with chloride no change • chlorine with bromide goes red/brown • chlorine with iodide goes brown • bromine with chloride no change • bromine with bromide no change • bromine with iodide goes brown • iodine with chloride no change • iodine with bromide no change • iodine with iodide no change **AO1.2 Trend in reactivity** • chlorine more reactive than bromine • chlorine more reactive than iodine • bromine more reactive than iodine **AO2.2 Explains link between observations and trend in reactivity** • chlorine displaces bromine so chlorine more reactive than bromine • chlorine displaces iodine so chlorine more reactive than iodine • bromine displaces iodine so bromine more reactive than iodine

Question			Answer	Marks	AO element	Guidance
8	(a)	(i)	Solid doesn't conduct electricity ✓ Ions (in solid) cannot move/no free ions ✓	2	2.1	
		(ii)	(Mixture has a lower melting point) therefore less energy /less fuel / less electricity needed (to make liquid) ✓	1	3.2a	
	(b)		**At positive electrode:** oxide ions lose electrons at positive electrode/anode ✓ to form oxygen gas ✓ **At negative electrode:** Aluminium ions gain electrons at negative electrode/cathode ✓ to form aluminium metal ✓	4	1.2	
	(c)	(i)	$2CuO + C \rightarrow 2Cu + CO_2$ Symbols/formulae correct ✓ Correctly balanced ✓	2	2.2	
		(ii)	Carbon more reactive than copper ✓ Carbon less reactive than aluminium ✓	2	2.1	
	(d)		**Any two advantages from:** Don't use energy/electricity ✓ works with low concentrations ✓ extracted from waste ✓ reduces need for new ores ✓ removes toxic waste ✓ **Any one disadvantage from:** slow ✓ use of acid ✓ not large quantities ✓	3	3.1b	Advantages = 2 marks Disadvantage = 1 mark

Question			Answer	Marks	AO element	Guidance
9	(a)	(i)	1 should be 1.0 ✓ no units added ✓	2	2.2	
		(ii)	know when to start adding slowly / add dropwise near the end / rough trial goes over the end point ✓	1	2.2	
		(iii)	Left out rough and repeat 3 ✓ Calculated mean of the other 3 ✓	2	2.2	
	(b)	(i)	**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 0.2 (g) award 3 marks** (volume =) 25 ÷1000 = 0.025 (dm^3) ✓ mass = 8 x 0.025 ✓ = 0.2 (g) ✓	3	 1.2 2.2 x 2	
		(ii)	23+16+1 = 40 ✓ 0.2÷40 = 0.005 ✓ 0.005 ÷ 2 (= 0.0025) ✓	3	2.2	**ALLOW** ECF from (i)
		(iii)	**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 0.11 (g) award 3 marks** 23.5 ÷ 1000 = 0.0235 (dm^3) ✓ 0.0025 ÷ 0.0235 = 0.1068.. ✓ = 0.11 (mol/dm^3) ✓	3	 1.2 2.2 1.2	**ALLOW** 0.106-0.107 on answer line for 2 marks **ALLOW** correct significant figures for incorrect calculation

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OCR (Oxford Cambridge and RSA Examinations)
The Triangle Building
Shaftesbury Road
Cambridge
CB2 8EA

OCR Customer Contact Centre

Education and Learning
Telephone: 01223 553998
Facsimile: 01223 552627
Email: general.qualifications@ocr.org.uk

www.ocr.org.uk

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