OCR
Oxford Cambridge and RSA

H

GCSE (9–1)

Chemistry A (Gateway Science)

J248/03: Paper 3 (Higher Tier)

General Certificate of Secondary Education

Mark Scheme for November 2020

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

1. 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

2. 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 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.

SECTION A

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	C ✓	1	2.2	
2	B ✓	1	1.2	
3	B ✓	1	2.1	
4	D ✓	1	1.1	
5	C ✓	1	1.1	
6	C ✓	1	2.1	
7	C ✓	1	1.1	
8	D ✓	1	1.1	
9	A ✓	1	1.1	
10	D ✓	1	2.2	
11	A ✓	1	2.1	
12	B ✓	1	2.2	
13	D ✓	1	1.1	
14	D ✓	1	1.1	
15	B ✓	1	2.1	

Question			Answer	Marks	AO element	Guidance
16	(a)	(i)	Ionic ✓ oppositely charged ions ✓	2	1.1	 **ALLOW** oppositely charged particles / has + and - particles **IGNORE** contains anions and cations (in diagram) **IGNORE** oppositely charged atoms / molecules **DO NOT ALLOW** positive nucleus and negative electrons **Mark independently**
		(ii)	**Any two from:** Idea of many strong ✓ covalent bonds ✓ (which) require a lot of energy to break ✓	2	1.1	**Reference to intermolecular forces / bonds / molecular forces scores 0 for question** **ALLOW** many covalent bonds break at high temperatures for 2 marks **ALLOW** idea that each atom has 4 strong covalent bonds for 2 marks **ALLOW** giant covalent structure for 1 mark
		(iii)	No delocalised electrons / no sea of electrons / no mobile charge carriers / ions / electrons / structure contains atoms ✓	1	1.1	**IGNORE** just free electrons
	(b)		Layers / metal ions ✓ slide over each other ✓	2	1.1	**IGNORE** metal atoms / electrons **Mark independently**

Question			Answer	Marks	AO element	Guidance
17	(a)		**Any two from:** In order of (increasing) atomic mass / weight ✓ In groups showing similar <u>chemical</u> properties ✓ Left gaps for elements that had not been discovered ✓	2	1.1	**ALLOW** (increasing) mass number **IGNORE** just in order of mass
	(b)		In order of (increasing) atomic number / proton number ✓	1	1.1	**IGNORE** electrons **DO NOT ALLOW** atomic mass
	(c)	(i)	Germanium ✓	1	3.1a	
		(ii)	Idea of similar atomic mass / 72.6 is closest to 72 / closest atomic mass ✓ Idea of similar density **/** 5.35 is closest to 5.5 / / closest density ✓	2	2 x 3.2a	**ALLOW** (Relative) atomic mass of 72.6 is very close to 72 **IGNORE** just atomic masses are 72 and 72.6 **ALLOW** density of 5.35 is very close to 5.5 **IGNORE** just densities are 5.35 and 5.5 **IGNORE** comments about melting point or colour If no marks awarded, **ALLOW** 1 for density and relative atomic mass and not melting point
	(d)	(i)	<u>Unreactive</u> ✓ Full outer shell (of electrons) ✓	2	2.1 1.1	**ALLOW** doesn't bond / doesn't lose or gain electrons / doesn't share electrons **ALLOW** (argon has a) stable electronic structure / 8 electrons in outer shell

Question			Answer	Marks	AO element	Guidance
		(ii)		3	2.1	1 mark for each row

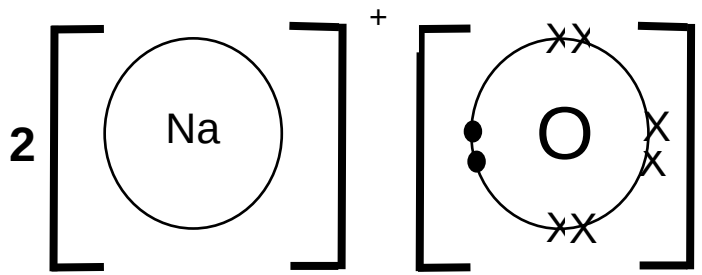
	$^{20}_{10}Ne$	$^{22}_{10}Ne$	
Proton	10	10	✓
Neutron	10	12	✓
Electron	10	10	✓

Question			Answer	Marks	AO element	Guidance
18	(a)	(i)	$Zn + 2HCl \rightarrow ZnCl_2 + H_2$ Reactants ✓ Balancing✓	2	2.2	**ALLOW** any correct multiple, including fractions **ALLOW** = **OR** ⇌ 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 eg Zn + 2HCL→ $ZnCl_2$ + H2
		(ii)	Exothermic ✓	1	1.1	
	(b)		Energy required to start the reaction / energy required for a successful collision to occur / AW ✓	1	1.1	**IGNORE** energy needed to activate the reaction / amount of energy for the reaction to take place
	(c)	(i)	Bond breaking is endothermic / takes in energy ✓ Bond making is exothermic / gives out energy ✓ More energy is given out (during bond making) than is taken in (during bond breaking) ✓	3	2 x 1.1 2.1	 **DO NOT ALLOW** ideas about more bonds **IGNORE** idea that more energy is **used** during bond making than is taken in during bond breaking **IGNORE** idea that it takes more energy to make bonds than to break bonds
		(ii)	C–H: 4 × 413 = 1652 **AND** O=O: 2 × 498 = 996 Total energy = 1652 + 996 = 2648 (kJ/mol) ✓	1	1.2	
		(iii)	C=O: 2 × 805 = 1610 **AND** O–H: 4 × 464 = 1856 Total energy = 1610 + 1856 = 3466 (kJ/mol) ✓	1	1.2	
		(iv)	Energy change = 2648 – 3466 = –818 (kJ/mol) ✓	1	1.2	Answer MUST show – sign for mark **ALLOW** ECF from parts (ii) & (iii)

Question			Answer	Marks	AO element	Guidance
19	(a)*		*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)** Detailed evaluation of the advantages and disadvantages of <u>all</u> of the pH testing kits A-E **AND** Suggested pH kit the farmer should use *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)** Evaluation of the advantages and disadvantages of some of the pH testing kits A-E **OR** Detailed evaluation of the advantages of <u>all</u> of the pH testing kits A-E **OR** Detailed evaluation of the disadvantages of <u>all</u> of the pH testing kits A-E **<u>AND</u>** Suggested pH kit the farmer should use **OR** Detailed evaluation of the advantages and disadvantages of <u>all</u> of the pH testing kits A-E *There is a line of reasoning presented with some structure. The information presented is relevant and supported by some evidence.*	6	6 × 3.2a	**AO3.2a Analyse information and ideas to make a judgement of which pH testing kit the farmer should use** **Advantages** • **A** is one of the least expensive testing kits • **A** changes colour across the pH scale • **A** can be used in acidic and alkaline soils • **D** is the least expensive **Disadvantages** • Idea that **B** and **D** only have two possible colours and therefore cannot tell you the pH • Idea that **C** and **E** don't change colour past pH 7, therefore is no use in alkaline soils • **E** is the most expensive **Choice** • **A** should be used by the farmer

Question			Answer	Marks	AO element	Guidance
			Level 1 (1–2 marks) Evaluation of the advantages of some of the pH testing kits A-E **OR** Evaluation of the disadvantages of some of the pH testing kits A-E **OR** Evaluation of the advantages and disadvantages of some of the pH testing kits A-E **AND** Suggested pH kit the farmer should use. *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.*			
	(b)		**FIRST CHECK ANSWER ON ANSWER LINE** **If answer = 297 award 3 marks** Relative formula mass of $MgCO_3$ = 24.3 + 12 + 16 × 3 = 84.3 ✓ Number of moles = 25 × $\frac{1000}{84.3}$ = 296.5599051 ✓ = 297 ✓ (to 3 sig fig)	**3**	**2.2 x 2** **1.2**	**DO NOT ALLOW** 84 **ALLOW ECF** from incorrect RFM of $MgCO_3$ eg RFM of 84, number of moles = 298 **ALLOW** ECF for sig fig mark

Question			Answer	Marks	AO element	Guidance
20	(a)	(i)	**FIRST CHECK ANSWER ON ANSWER LINE** **If answer = 0.62 award 3 marks** R_f = <u>distance travelled by substance</u> = 37/60 ✓ distance travelled by solvent = 0.61666…. ✓ = 0.62 (**2 significant figures**) ✓	**3**	**1.1** **2.2** **1.2**	 **ALLOW** ECF for use of correct calculation from incorrect measurements **ALLOW** 0.59 – 0.67 **ALLOW** ECF for sig fig mark
		(ii)	A **<u>and</u>** B	**1**	**3.2a**	Both needed for the mark
		(iii)	Idea that D forms weak(er) bonds with the mobile phase than C / Idea that D forms strong(er) bonds with stationary phase than C / D is less polar than C / ORA ✓	**1**	**2.1**	**ALLOW** C is more soluble (in the solvent) than D / ORA
	(b)	**(i)**	Similarity: Both have stationary and mobile phases / both use silica in the stationary phase ✓ Difference: Thin-layer uses liquid for mobile phase / gas chromatography use gas for mobile phase ✓	**2**	**2 x 1.1**	 **ALLOW** the mobile phases are different states
		(ii)	Thin-layer chromatography is used to separate solids / gas chromatography is used to separate gases (in a gas mixture) ✓	**1**	**2.1**	**ALLOW** idea that the tomato sauce is a liquid or not a gas

Question			Answer	Marks	AO element	Guidance
21	(a)		 Outer shells correctly drawn ✓ Correct charges ✓	2	2.1	**ALLOW** all dots / all crosses / mix of dots and crosses **ALLOW** eight electrons shown on outer shell of sodium ion **ALLOW** just one sodium ion drawn **If inner shells are drawn, they must be correct** **ALLOW** 1 mark for correct diagram of either a Na^+ or O^{2-} ion, if no other mark awarded
	(b)	(i)	Na_2O (s) + H_2O (l) → **2**NaOH (aq) Formulae ✓ Balancing ✓ State symbols ✓	3	2.1 1.2 2.1	**ALLOW** any correct multiple, including fractions **ALLOW** = **OR** ⇌ 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 e.g. NAO + H_2O →**2**NaOH State symbols mark is independent of formulae & balancing marks
		(ii)	Hydroxide / OH^- ions ✓	1	1.1	
		(iii)	Sodium sulfate✓	1	2.1	**ALLOW** Na_2SO_4 **IGNORE** incorrect formulae if correct name is given

Question			Answer	Marks	AO element	Guidance
		(iv)	**FIRST CHECK ANSWER ON ANSWER LINE** **If answer = 100 award 2 marks** pH increased by 2 concentration decreases by a factor of 10 × 10 ✓ 100 ✓	**2**	**2.2**	**ALLOW** for 1 mark pH increase by 1, so concentration decreased by a factor of 10

Question			Answer	Marks	AO element	Guidance
22	(a)	(i)	x- axis: mass of copper carbonate (g) **AND** y-axis: mass of copper oxide(g) ✓ Appropriate scale ✓ All points plotted correctly ✓ Line of best fit through the points ✓	4	4 x 2.2 1.2	**ALLOW** correct formulae**,** ie $CuCO_3$ and CuO **ALLOW** just copper carbonate (g) **AND** copper oxide(g) **ALLOW** ± ½ square **ALLOW** line that starts at (1, 0.7) and does not go through (0,0) **ALLOW** correctly drawn line of best fit through incorrectly drawn points; this may be a curve
		(ii)	3.8(0) (g) ✓	1	3.1a	**ALLOW** ± ½ square **ALLOW** ECF from graph
		(iii)	Idea that carbon dioxide (gas) escapes ✓	1	3.2b	**ALLOW** idea that a gas is produced / escapes, but **DO NOT ALLOW** incorrectly named gas
	(b)		**FIRST CHECK ANSWER ON ANSWER LINE** **If answer = 373 (tonnes) award 4 marks** M_r $CaCO_3$ = 100.1 **and** M_r CaO = 56.1 ✓ 209 g of calcium oxide = $\frac{100.1}{56.1} \times 209$ ✓ = 372.9215686 (g) ✓ = 373 (g) (**3 significant figures**) ✓	4	3 x 2.2 1.2	Need both relative formula masses for 1 mark **DO NOT ALLOW** 100 or 56 **ALLOW** ECF from incorrect RFMs **ALLOW** ECF **ALLOW** ECF for sig fig mark

Question			Answer	Marks	AO element	Guidance
23	(a)	(i)	Cu^{2+}, SO_4^{2-}, H^+, OH^-	2	2.2	All 4 ions correct for 2 marks 2 or 3 ions correct for 1 mark
	(b)		Idea that inert electrodes do not react with the electrolyte / inert electrodes are unreactive ✓	1	1.2	**ALLOW** so that electrodes do not take part in the reaction
	(c)	(i)	Copper sulfate ✓	1	3.2a	
		(ii)	Copper chloride produces chlorine which is a toxic gas / copper sulfate does not produce chlorine which is a toxic gas ✓ Zinc bromide / sulfuric acid do not have copper ions **OR** copper sulfate / copper chloride contain copper ions ✓	2	2 × 3.2b	**IGNORE** idea that chlorine gas is dangerous / hazardous **ALLOW** idea that the solution contains copper ions
	(d)	(i)	Oxygen / O_2 ✓	1	3.2a	**IGNORE** O
		(ii)	Hydrogen is less reactive than sodium / ORA ✓	1	3.2b	**Assume unqualified answer refers to hydrogen (gas)**

Question			Answer	Marks	AO element	Guidance
		(iii)	$2H^+ + 2e^- \rightarrow H_2$ Formula ✓ Balancing ✓	2	2.1 1.2	**ALLOW** any correct multiple, including fractions **ALLOW** = **OR** ⇌ instead of → **DO NOT ALLOW** and / & instead of '+' **ALLOW** e for e^- Balancing mark is dependent on the correct formulae but **ALLOW** 1 mark for a balanced equation with a minor error in subscripts / formulae e.g. 2H+ + 2e → H2
	(e)		Aqueous solutions contain H^+ and OH^- ions / molten state does not contain H^+ and OH^- ions ✓	1	1.2	

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