GCSE (9–1)

Chemistry A (Gateway Science)

J248/02: Paper 2 (Foundation Tier)

General Certificate of Secondary Education

2021 Mark Scheme (DRAFT)

This is a DRAFT mark scheme. It has not been used for marking as this paper did not receive any entries in the series it was scheduled for. It is therefore possible that not all valid approaches to a question may be captured in this version. You should give credit to such responses when marking learner's work.

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.

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

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
16	(a)		They all have one electron in the outer shell ✓	1	1.1	**ALLOW** they all have the same number of electrons in the outer shell / they all form 1+ ions **IGNORE** they have the same number of electrons
	(b)	(i)	Hydrogen ✓	1	1.2	**ALLOW** H_2 **DO NOT ALLOW** H
		(ii)	Lighted splint ✓ (makes a squeaky) pop ✓	2	1.2	 **ALLOW** 'the squeaky pop test' for 1 mark

Question			Answer	Marks	AO element	Guidance
16	(b)	(iii)*	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)** Analyses the observations to predict what you would see and the reaction time with rubidium. **AND** Uses knowledge of the reactions of the alkali metals to write a correct word or symbol equation for the reaction. *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)** Analyses the observations to predict some observations and compares the reaction time with rubidium with that of potassium. **AND** Uses knowledge of the reactions of the alkali metals to attempt a correct word or symbol equation for the reaction or give the name of formula of a product formed in the reaction. *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)** Analyses the observations to predict some observations with rubidium. **OR** Uses knowledge of the reactions of the alkali metals to attempt a correct word or symbol equation for the reaction	6	2 x 1.2 4 x 3.2a	**AO3.2a** **Observations with rubidium:** • bubbles / fizzes / effervescence • hydrogen made • floats • moves quickly across the surface of the water • gives a flame • explodes • makes an alkaline solution • forms a colourless solution • piece of rubidium gets smaller **Reaction time:** • any time less than 6s **ALLOW** statement that reaction is **faster** than potassium at Levels 1 & 2 **AO1.2** Word equation: rubidium + water → rubidium hydroxide + hydrogen Symbol equation: $2Rb + 2H_2O \rightarrow 2RbOH + H_2$ (need not be balanced)

Question			Answer	Marks	AO element	Guidance
			or give the name of formula of a product formed in the reaction. *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.*			

Question			Answer	Marks	AO element	Guidance
17	(a)		Contains carbon and hydrogen ✓ only ✓	2	1.1	**Second marking point is dependent on the first** **ALLOW** (formula) has only ✓ C and H ✓ **DO NOT ALLOW** contains carbon and hydrogen molecules / contains a mixture of carbon and hydrogen **DO NOT ALLOW** contains carbon and hydro
	(b)		Contains (carbon to carbon) single bonds **only** / Contains single (covalent) bonds **only** ✓	1	1.1	**ALLOW** has no (carbon to carbon) double bonds **IGNORE** has the maximum amount of hydrogen atoms
	(c)		Answer in range 135 – 185 (°C) ✓	1	3.2a	**ALLOW** answer written in table if answer line is blank
	(d)		Idea that hydrocarbons have different boiling points ✓ **And any two from:** Larger molecules or longer chains have higher boiling points / ORA ✓ Larger molecules or longer chains have stronger intermolecular forces / ORA ✓ Idea that stronger intermolecular forces results in higher boiling point / ORA ✓	3	1 x 2.1 2 x 1.1	**ALLOW** pentadecane for larg**er** molecules or hexane for small**er** molecules throughout the question **IGNORE** melting points **ALLOW** molecules with higher mass have higher boiling points / ORA **ALLOW** larger molecules or longer chains have more intermolecular forces / ORA **ALLOW** idea that stronger intermolecular forces results in more energy needed (to boil) / ORA

Question			Answer	Marks	AO element	Guidance
	(e)		C_9H_{20} + **14**O_2 → **9**CO_2 + **10**H_2O right hand side correct ✓ left hand side correct ✓	2	2.1	
	(f)		(Carbon monoxide) is poisonous / toxic ✓ (Carbon monoxide) can cause difficulty breathing or suffocation / attaches to the haemoglobin (protein) in red blood cells / reduces the amount of oxygen that the blood can carry / can cause drowsiness / can cause death ✓	2	1.1	**IGNORE** harmful / dangerous

Question			Answer	Marks	AO element	Guidance
18	(a)		Reversible reaction / reaction can go both ways ✓	1	1.1	**ALLOW** equilibrium
	(b)	(i)	30 (%) ✓	1	2.1	
		(ii)	**Temperature** – 350 (°C) **Pressure** – 600 (atmospheres) ✓	1	2.1	**BOTH required for the mark**
	(c)		$NH_3 + HNO_3 \rightarrow NH_4NO_3$ ✓	1	2.1	**ALLOW** any correct multiple, including fractions **DO NOT ALLOW** and / & instead of '+'
	(d)		Sulfuric acid ✓	1	2.2	**ALLOW** H_2SO_4
	(e)		Increase crop yield / idea of providing or replacing essential elements / to provide nitrogen or phosphorus or potassium ✓	1	1.1	**ALLOW** idea of making plants grow well **BUT IGNORE** just to make plants grow
	(f)		Potassium chloride ✓	1	3.2b	**ALLOW** correct answer ticked, circled or underlined on graph if tick box is blank
	(g)	(i)	Idea of adding acid until the indicator changes colour (completely) ✓	1	3.3b	**ALLOW** add excess of dilute acid
		(ii)	Carry out experiment in a fume cupboard or well ventilated room / use low concentrations of ammonia ✓	1	2.2	**ALLOW** goggles / gloves

Question			Answer	Marks	AO element	Guidance
	(h)		**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 506 (tonnes) award 4 marks** M_r of HNO_3 = 63.0 **AND** KNO_3 = 101.1 ✓ Mass of potassium nitrate = $\frac{101.1}{63}$ x 315 / 1.605 x 315 ✓ = 505.5 (tonnes) ✓ To **3 sig figs** = 506 (tonnes) ✓	**4**	**2.2**	 **ALLOW** ECF from incorrect M_r values **ALLOW** ECF

Question			Answer	Marks	AO element	Guidance
19	(a)		Gas syringe ✓	1	3.3b	**ALLOW** burette
	(b)		Limewater ✓ Turns milky / cloudy ✓	2	1.2	Result is dependent on correct test.
	(c)	(i)	30 (s) ✓	1	2.2	
		(ii)	Line starting at origin but less steep than original line ✓ Levels off at exactly 40 cm^3 ✓	2	2.2	
	(d)		**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 83(%) award 3 marks** % yield = $\frac{0.073}{0.088}$ x 100 ✓ = 82.95 (%) ✓ To 2 **sig figs** = 83 (%) ✓	3	2.2	**ALLOW** % yield = (am ÷ pm) x 100 for 1 mark if no other mark awarded **ALLOW** ECF
	(e)		Idea that results show that as the temperature increases (the time decreases so) the rate increases ✓ **AND ANY TWO FROM:** idea that acid particles move faster / particles have more energy ✓ idea of more collisions per second / collisions more often / increased collision frequency / more chance of a collision ✓ idea of more successful collisions / collisions between marble chips and acid are more energetic ✓	3	**2 x 2.2** **1 x 1.2**	**ALLOW** ORA throughout **IGNORE** references to 'faster' collisions

Question			Answer	Marks	AO element	Guidance
20	(a)		**Metal** – aluminium ✓ **Explanation:** Low density ✓ Does not corrode ✓ Idea that cost is not too expensive ✓	4	2 x 2.1 2 x 3.2a	**ALLOW** light weight but **DO NOT ALLOW** light
	(b)		Copper / Cu ✓	1	1.1	
	(c)		(The nail will rust in) Tube **A** ✓ **And any three from:** Tube **A** contains air/oxygen and water ✓ In Tube **B** the drying agent absorbs water / there is no water ✓ Tube **C** has water but no air/oxygen ✓ In Tube **C** oil prevents air being absorbed ✓ Water **and** air/oxygen are needed for rusting ✓	4	2 x 1.2 2 x 2.2	

Question			Answer	Marks	AO element	Guidance
	(d)		Painting ✓ Idea of stopping air and/or water reaching the iron ✓ **OR** Coating with oil / grease / plastic ✓ Idea of stopping air and/or water reaching the iron ✓ **OR** Plating with zinc / galvanising ✓ Idea of stopping air and/or water reaching the iron / idea of sacrificial protection / zinc reacts instead of iron ✓ **OR** Plating with tin ✓ Idea of stopping air and/or water reaching the iron ✓	**2**	**1.1**	**ALLOW** correct higher level explanation of sacrificial protection in terms of electron loss

Question			Answer	Marks	AO element	Guidance
21	(a)		**Any three from:** **Mass spectrum** Highest m/z value or molecular ion peak is at 46 which is the M_r of ethanol ✓ Peak at m/z = 31 indicates -CH_2OH group ✓ Peak at m/z = 15 indicates -CH_3 group ✓ **Infrared spectrum** Idea that IR spectrum shows peak in range 3230-3550 which indicates an O-H bond ✓ Idea that IR spectrum shows peak at approx. 1050 which indicates a C-C bond ✓ Idea that IR spectrum shows peak at just below 3000 which indicates a C-H bond ✓ Idea that IR spectrum shows peak at approx. 1100 which indicates a C-O bond ✓	3	3.1b	**ALLOW** m/z value linked to any other molecular fragment **ALLOW** correct link between wavenumber and bond <u>from spectrum</u>
	(b)		**Any two from:** More sensitive / can analyse very small amounts of substances ✓ More accurate ✓ Faster / can carry out analysis all the time ✓	2	1.1	**IGNORE** more precise
	(c)	(i)	$C_2H_5OH + 3O_2 \rightarrow 2CO_2 + 3H_2O$ Formulae ✓ Balancing ✓	2	1.1 2.1	**ALLOW** any correct multiple, including fractions **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. C2H5Oh + $3O_2 \rightarrow 2CO_2 + 3H_2O$

Question			Answer	Marks	AO element	Guidance
	(c)	(ii)	Produces soot / produces carbon monoxide / produces less energy ✓	1	1.1	**ALLOW** produces a toxic or poisonous gas **IGNORE** produces a harmful gas
	(d)		**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 61 / 60.9 / 60.87 (%) award 2 marks** Atom economy = $\frac{28.0}{(28.0 + 18.0)} \times 100 \; / \; \frac{28.0}{46.0} \times 100$ ✓ = 61(%) / 60.9 (%) / 60.87(%) ✓	2	2.1	**ALLOW** atom economy formula in words for one mark i.e. atom economy = $\frac{\text{total Mr of desired products}}{\text{total Mr of all products}} \times 100$ **ALLOW** ECF **ALLOW** any correct rounding from calculator value, 60.86956522

Question			Answer	Marks	AO element	Guidance
22	(a)	(i)	Idea of looking at each stage of the life of a product to work out the potential environmental impact at each stage ✓	1	1.1	
		(ii)	**Any two from:** Raw materials needed ✓ Energy used in processing or manufacturing ✓ Water used in processing or manufacturing ✓ Energy needed to <u>use</u> the product ✓ Energy needed to <u>maintain</u> the product ✓ Water or other substances needed to maintain the product ✓ Energy needed to <u>dispose</u> of the product ✓ Space needed to dispose of the product ✓	2	1.1	**ALLOW** sustainability **ALLOW** idea of environmental impact of transporting raw materials **ALLOW** do the materials used decompose or break down **ALLOW** can the product be recycled **IGNORE** references to cost **IGNORE** references to waste products or pollution (stem of question)
	(b)	(i)	Vehicle operation ✓	1	3.1a	

Question			Answer	Marks	AO element	Guidance
		(ii)	**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 9.5 (tonnes) award 2 marks** Mass of CO_2 produced by petrol car = 80% of 29.8 tonnes = 23.84 (tonnes) ✓ Mass of CO_2 produced by diesel car = 70% of 20.5 tonnes = 14.35 (tonnes) ✓ Difference = 23.84 – 14.35 = 9.49 (tonnes) ✓ To **2 sig figs** = 9.5 (tonnes) ✓	**4**	**3.2b**	 **ALLOW** ECF **ALLOW** ECF **ALLOW** 1 mark for correct identification of percentages of CO_2 from vehicle operation for each car (petrol – 80%, diesel – 70%), if no other mark awarded **ALLOW** answers given to 2 sig figs throughout the question, i.e. Mass of CO_2 produced by petrol car = 24 (tonnes) Mass of CO_2 produced by diesel car = 14 (tonnes) Difference = 10 (tonnes)

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