

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.

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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
BOD	Benefit of doubt given
CON	Contradiction
RE	Rounding error
SF	Error in number of significant figures
ECF	Error carried forward
L1	Level 1
L2	Level 2
L3	Level 3
NBOD	Benefit of doubt not given
SEEN	Noted but no credit given
I	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)*	<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 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.</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 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 <u>or</u> symbol equation for the reaction or give the name of formula of a product formed in the reaction.</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) Analyses the observations to predict some observations with rubidium. OR Uses knowledge of the reactions of the alkali metals to attempt a correct word <u>or</u> symbol equation for the reaction</p>	6	2 x 1.2 4 x 3.2a	<p>AO3.2a Observations with rubidium:</p> <ul style="list-style-type: none"> • 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 <p>Reaction time:</p> <ul style="list-style-type: none"> • any time less than 6s <p>ALLOW statement that reaction is faster than potassium at Levels 1 & 2</p> <p>AO1.2 Word equation: rubidium + water → rubidium hydroxide + hydrogen</p> <p>Symbol equation: $2\text{Rb} + 2\text{H}_2\text{O} \rightarrow 2\text{RbOH} + \text{H}_2$ (need not be balanced)</p>

Question	Answer	Marks	AO element	Guidance
	<p>or give the name of formula of a product formed in the reaction.</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 <i>No response or no response worthy of credit.</i></p>			

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 larger molecules or hexane for smaller 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)	$\text{C}_9\text{H}_{20} + 14\text{O}_2 \rightarrow 9\text{CO}_2 + 10\text{H}_2\text{O}$ 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)	$\text{NH}_3 + \text{HNO}_3 \rightarrow \text{NH}_4\text{NO}_3$ ✓	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)	<p>FIRST CHECK THE ANSWER ON ANSWER LINE If answer = 506 (tonnes) award 4 marks</p> <p>M_r of HNO_3 = 63.0 AND KNO_3 = 101.1 ✓</p> <p>Mass of potassium nitrate = $\frac{101.1 \times 315}{63} / 1.605 \times 315$ ✓</p> <p style="padding-left: 100px;">= 505.5 (tonnes) ✓</p> <p>To 3 sig figs = 506 (tonnes) ✓</p>	4	2.2	<p>ALLOW ECF from incorrect M_r values</p> <p>ALLOW ECF</p>

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 = $\frac{0.073}{0.088} \times 100$ ✓ = 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)	<p>Metal – aluminium ✓</p> <p>Explanation: Low density ✓ Does not corrode ✓ Idea that cost is not too expensive ✓</p>	4	2 x 2.1 2 x 3.2a	ALLOW light weight but DO NOT ALLOW light
	(b)	Copper / Cu ✓	1	1.1	
	(c)	<p>(The nail will rust in) Tube A ✓</p> <p>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 ✓</p>	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)	<p>Any three from:</p> <p>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 -CH₂OH group ✓ Peak at m/z = 15 indicates -CH₃ group ✓</p> <p>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 ✓</p>	3	3.1b	<p>ALLOW m/z value linked to any other molecular fragment</p> <p>ALLOW correct link between wavenumber and bond <u>from spectrum</u></p>	
	(b)	<p>Any two from:</p> <p>More sensitive / can analyse very small amounts of substances ✓</p> <p>More accurate ✓</p> <p>Faster / can carry out analysis all the time ✓</p>	2	1.1	<p>IGNORE more precise</p>	
	(c)	(i)	<p>$C_2H_5OH + 3O_2 \rightarrow 2CO_2 + 3H_2O$</p> <p>Formulae ✓ Balancing ✓</p>	2	1.1 2.1	<p>ALLOW any correct multiple, including fractions DO NOT ALLOW and / & instead of '+'</p> <p>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. $C_2H_5Oh + 3O_2 \rightarrow 2CO_2 + 3H_2O$</p>

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)	<p>Any two from:</p> <p>Raw materials needed ✓</p> <p>Energy used in processing or manufacturing ✓</p> <p>Water used in processing or manufacturing ✓</p> <p>Energy needed to <u>use</u> the product ✓</p> <p>Energy needed to <u>maintain</u> the product ✓</p> <p>Water or other substances needed to maintain the product ✓</p> <p>Energy needed to <u>dispose</u> of the product ✓</p> <p>Space needed to dispose of the product ✓</p>	2	1.1	<p>ALLOW sustainability</p> <p>ALLOW idea of environmental impact of transporting raw materials</p> <p>ALLOW do the materials used decompose or break down</p> <p>ALLOW can the product be recycled</p> <p>IGNORE references to cost</p> <p>IGNORE references to waste products or pollution (stem of question)</p>
	(b)	(i)	Vehicle operation ✓	1	3.1a	

Question	Answer	Marks	AO element	Guidance
	<p>(ii) FIRST CHECK THE ANSWER ON ANSWER LINE If answer = 9.5 (tonnes) award 2 marks</p> <p>Mass of CO₂ produced by petrol car = 80% of 29.8 tonnes = 23.84 (tonnes) ✓</p> <p>Mass of CO₂ produced by diesel car = 70% of 20.5 tonnes = 14.35 (tonnes) ✓</p> <p>Difference = 23.84 – 14.35 = 9.49 (tonnes) ✓</p> <p>To 2 sig figs = 9.5 (tonnes) ✓</p>	4	3.2b	<p>ALLOW ECF</p> <p>ALLOW ECF</p> <p>ALLOW 1 mark for correct identification of percentages of CO₂ from vehicle operation for each car (petrol – 80%, diesel – 70%), if no other mark awarded</p> <p>ALLOW answers given to 2 sig figs throughout the question, i.e. Mass of CO₂ produced by petrol car = 24 (tonnes) Mass of CO₂ produced by diesel car = 14 (tonnes) Difference = 10 (tonnes)</p>

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