

**GCSE (9–1)**

**Chemistry A**

**(Gateway Science)**

**J248/02: Paper 2 (Foundation Tier)**

General Certificate of Secondary Education

**Mark Scheme for June 2019**

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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 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

Abbreviations, annotations and conventions used in the detailed Mark Scheme (to include abbreviations and subject-specific conventions).

<b>Annotation</b>	<b>Meaning</b>
/	alternative and acceptable answers for the same marking point
✓	Separates marking points
<b>DO NOT ALLOW</b>	Answers which are not worthy of credit
<b>IGNORE</b>	Statements which are irrelevant
<b>ALLOW</b>	Answers that can be accepted
( )	Words which are not essential to gain credit
—	Underlined words must be present in answer to score a mark
<b>ECF</b>	Error carried forward
<b>AW</b>	Alternative wording
<b>ORA</b>	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 Chemistry A:

	<b>Assessment Objective</b>
<b>AO1</b>	<b>Demonstrate knowledge and understanding of scientific ideas and scientific techniques and procedures.</b>
AO1.1	Demonstrate knowledge and understanding of scientific ideas.
AO1.2	Demonstrate knowledge and understanding of scientific techniques and procedures.
<b>AO2</b>	<b>Apply knowledge and understanding of scientific ideas and scientific enquiry, techniques and procedures.</b>
AO2.1	Apply knowledge and understanding of scientific ideas.
AO2.2	Apply knowledge and understanding of scientific enquiry, techniques and procedures.
<b>AO3</b>	<b>Analyse information and ideas to interpret and evaluate, make judgements and draw conclusions and develop and improve experimental procedures.</b>
<b>AO3.1</b>	Analyse information and ideas to interpret and evaluate.
AO3.1a	Analyse information and ideas to interpret.
AO3.1b	Analyse information and ideas to evaluate.
<b>AO3.2</b>	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.
<b>AO3.3</b>	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	C ✓	1	1.1	
2	D ✓	1	1.1	
3	C ✓	1	1.2	
4	C ✓	1	1.2	
5	D ✓	1	1.1	
6	C ✓	1	2.1	
7	C ✓	1	1.1	
8	A ✓	1	1.2	
9	C ✓	1	1.1	
10	A ✓	1	1.1	
11	D ✓	1	1.1	
12	B ✓	1	1.1	
13	C ✓	1	1.1	
14	D ✓	1	2.2	
15	D ✓	1	1.1	

Question		Answer	Marks	AO element	Guidance
16	(a)	<p>Tube A (nail) will rust because water AND air/oxygen are present ✓</p> <p>Tube B no rust/change as there is no air/oxygen present ✓</p> <p>Tube C no rust/change as there is no water present ✓</p>	3	2.2	<p><b>Observation AND explanation needed for each mark</b></p> <p><b>ALLOW</b> For Tube A idea of suitable colour change e.g. red/orange.</p> <p><b>Allow</b> 'nothing happens'</p> <p><b>ALLOW</b> 'because it's dry' as the reason</p> <p><b>ALLOW</b> One mark for getting all three observations as a standalone mark</p>
	(b)	<p>(Oil) prevents water (reaching the iron) ✓</p> <p>(Oil) prevents air / oxygen (reaching the iron) ✓</p>	2	1.1	<p><b>IGNORE</b> other detail which doesn't contradict the answer 'lubricates the chain so it doesn't absorb water'</p>
	(c)	<p>(Iron has not rusted because) zinc is more reactive (than iron) / ora ✓</p> <p>(so) zinc corrodes instead of iron / zinc acts as a sacrificial metal ✓</p>	2	1.1	<p><b>Marks are for explanation</b></p>



Question		Answer	Marks	AO element	Guidance												
17	(a)	<table border="1"> <thead> <tr> <th>Name of alkane</th> <th>Molecular formula</th> <th>Structure</th> </tr> </thead> <tbody> <tr> <td>Methane</td> <td>CH<sub>4</sub></td> <td> <pre>       H         H — C — H               H           </pre> </td> </tr> <tr> <td>Ethane</td> <td>C<sub>2</sub>H<sub>6</sub> ✓</td> <td> <pre>       H   H             H — C — C — H                   H   H           </pre> </td> </tr> <tr> <td><b>Butane</b> ✓</td> <td>C<sub>4</sub>H<sub>10</sub></td> <td> <pre>       H   H   H   H                     H — C — C — C — C — H                           H   H   H   H           </pre>           ✓         </td> </tr> </tbody> </table>	Name of alkane	Molecular formula	Structure	Methane	CH <sub>4</sub>	<pre>       H         H — C — H               H           </pre>	Ethane	C <sub>2</sub> H <sub>6</sub> ✓	<pre>       H   H             H — C — C — H                   H   H           </pre>	<b>Butane</b> ✓	C <sub>4</sub> H <sub>10</sub>	<pre>       H   H   H   H                     H — C — C — C — C — H                           H   H   H   H           </pre> ✓	3	1.1	
Name of alkane	Molecular formula	Structure															
Methane	CH <sub>4</sub>	<pre>       H         H — C — H               H           </pre>															
Ethane	C <sub>2</sub> H <sub>6</sub> ✓	<pre>       H   H             H — C — C — H                   H   H           </pre>															
<b>Butane</b> ✓	C <sub>4</sub> H <sub>10</sub>	<pre>       H   H   H   H                     H — C — C — C — C — H                           H   H   H   H           </pre> ✓															
	(b)	<p><b>Hydrocarbon because</b> contains only carbon and hydrogen ✓</p> <p><b>Saturated because</b> contains single (covalent) bonds <u>only</u> / AW ✓</p>	2	2.1	<p><b>ALLOW</b> fits the general formula C<sub>n</sub>H<sub>2n+2</sub></p> <p><b>ALLOW</b> has only H and C ✓</p> <p><b>DO NOT ALLOW</b> contains carbon and hydrogen molecules / contains a mixture of carbon and hydrogen</p> <p><b>ALLOW</b> does not have a double bond</p> <p><b>IGNORE</b> 'saturated because not an alkene/ because all its carbons have 4 bonds</p>												

17	(c)	<p>Ethane – bromine water remains orange / orange-brown ✓</p> <p>Ethene – bromine water is decolourised / turns colourless ✓</p>	2	2.2	<p><b>IGNORE</b> No change</p> <p><b>IGNORE</b> turns clear / disappears</p>
	(d)	Alkene(s) ✓	1	1.1	
	(e)	<p><math>C_5H_{12} + 8O_2 \rightarrow 5CO_2 + 6H_2O</math></p> <p>Formulae ✓</p> <p>Balancing ✓</p>	2	2.2	<p><b>ALLOW</b> any correct multiple, including fractions <b>DO NOT ALLOW</b> 'and'/'&amp;' instead of '+'</p> <p>Balancing mark is dependent on the correct formulae but <b>ALLOW</b> 1 mark for a balanced equation with a minor error in subscripts / formulae eg <math>C_5H_{12} + 8O_2 \rightarrow 5Co_2 + 6h_2O</math></p>

Question			Answer	Marks	AO element	Guidance
18	(a)	(i)	(iron oxide + carbon → ) <b>iron + carbon dioxide</b> ✓	1	2.1	<b>ALLOW</b> carbon monoxide / carbon oxide <b>ALLOW</b> symbols if correct
		(ii)	Oxygen is removed (from iron oxide) ✓	1	2.1	The mark is for the process of reduction, not the products. 'It' refers to iron oxide  <b>ALLOW</b> iron separates from the oxygen <b>BOD</b> <b>ALLOW</b> oxide is removed <b>IGNORE</b> oxygen is formed, iron is formed <b>ALLOW</b> iron <b>gains</b> electrons <b>IGNORE</b> electrons are gained
	(b)	(i)	Carbon is more reactive (than zinc) ✓	1	2.1	<b>ALLOW</b> carbon displaces zinc from zinc oxide <b>ALLOW</b> carbon is higher (in the table) / above zinc <b>IGNORE</b> carbon is highly reactive
		(ii)	Idea that aluminium is more reactive (than carbon) ✓	1	2.1	<b>IGNORE</b> aluminium is reactive / quite reactive <b>ALLOW</b> aluminium is highly / too / very reactive <b>ALLOW</b> aluminium is higher (in the table) / above carbon
	(c)		Zinc costs more than aluminium / ORA ✓  Amount of zinc in the Earth's crust is much less (than the amount of aluminium) / ORA ✓	2	3.2a	'It' refers to zinc <b>ALLOW</b> It's expensive <b>ALLOW</b> There's less of it <b>ALLOW</b> only a small amount of zinc (in Earth's crust)
	(d)		<b>FIRST CHECK THE ANSWER ON ANSWER LINE</b> <b>If answer = 2.85 (%) award 4 marks</b>  $1.28 \text{ (g)} + 43.70 \text{ (g)} = 44.98 \text{ (g)}$ ✓  $\frac{1.28 \times 100}{44.98}$ ✓  $= 2.8457 \dots$ ✓  $= 2.85 \text{ (3 sig. figs)}$ ✓	4	  <b>3x2.2</b>          <b>1.2</b>	Candidates who divide by 43.70 instead of 44.98 are carrying out a very similar calculation, so can score the remaining three marks ie $\frac{1.28 \times 100}{43.70} = 2.92906 = 2.93 \text{ (3 sig. figs)}$ ✓✓✓  Allow the sig figs mark for any other incorrect calculation which leads to an answer that needs shortening.

Question			Answer	Marks	AO element	Guidance
19	(a)	(i)	Idea that rate of forward reaction equals rate of backward reaction ✓	1	1.1	<b>ALLOW</b> balanced / becomes the same <b>IGNORE</b> stays the same
		(ii)	Idea that the concentrations of the reacting substances remain constant ✓	1	1.1	<b>ALLOW</b> stays the same / unchanged <b>IGNORE</b> 'are' the same
	(b)	(i)	Phosphorus ✓  Potassium ✓	2	1.1	<b>ALLOW</b> P, K  <b>ALLOW</b> oxygen/O/ sulfur/S <b>IGNORE</b> radicals eg sulfate / phosphate
	(c)		Heat the solution / to evaporate (most of the water) ✓  Dry in a warm oven / dry in air ✓	2	2.2	<b>IGNORE</b> allow to crystallise unless detail given (stem) <b>IGNORE</b> 'dry it' / 'let it dry out' unless detail given
	(d)		<b>Explanation must match the description</b> <b>Any pair from:</b> Add <b>excess</b> / more sodium sulfate (rather than a few drops) ✓ (so) more reaction occurs / forms more calcium sulfate ✓ <b>OR</b> Filter the reaction mixture (rather than pouring off the liquid) ✓ (so) none/less of the calcium sulfate is lost ✓ <b>OR</b> Wash the calcium sulfate ✓ (so) the impurities are removed ✓ <b>OR</b> Put the calcium sulfate in an oven / warm place ✓ (so) the calcium sulfate is dry ✓	4	4 x3.3b	<b>ALLOW</b> other suitable points  <b>IGNORE</b> increase the calcium nitrate / both reactants  <b>IGNORE</b> crystallisation  <b>IGNORE</b> Idea of evaporation

Question	Answer	Marks	AO element	Guidance
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Question		Answer	Marks	AO element	Guidance
20	(a)	Z ✓	1	2.1	
	(b)	<p><b>FIRST CHECK ANSWER ON ANSWER LINE</b>  <b>If answer = 40.31(kg) award 2 marks</b></p> <p><math>\frac{29}{100} \times 139 \checkmark</math>  <math>= 40.31(\text{kg}) \checkmark</math></p>	2	2.2	<p><b>ALLOW</b> 40.3 / 40 ✓✓</p> <p><b>ALLOW</b> ecf for one mark if 26% or 28% used (=36.14 or 38.92) ✓</p>
	(c)	$\text{C}_{16}\text{H}_{34} \checkmark$	1	2.1	<b>ALLOW</b> $\text{H}_{34}\text{C}_{16}$
	(d)	<p>(i) <b>Any two from:</b>            idea that decane boils / evaporates / turns into gaseous decane ✓</p> <p>Idea that decane (vapour or gas) reacts /breaks down as it comes into contact with the porcelain chips ✓</p> <p>Idea that large molecules of decane produce smaller molecules like ethene ✓</p>	2	1.2	<p><b>ALLOW</b> passed over hot catalyst  <b>ALLOW</b> liquid decane reacts with chips BOD</p>
		(ii) $\text{C}_6\text{H}_{14} \checkmark$	1	2.2	<p><b>ALLOW</b> <math>\text{H}_{14}\text{C}_6</math>  <b>ALLOW</b> if the candidate tries to write an (erroneous) equation for cracking and gives it as a product</p>

Question		Answer	Marks	AO element	Guidance
21	(a)	$\text{Mg} + 2\text{HCl} \rightarrow \text{MgCl}_2 + \text{H}_2$ Formulae ✓ Balancing ✓	2	2.2	<p><b>ALLOW</b> any correct multiple, including fractions  <b>DO NOT ALLOW</b> 'and/&amp;' instead of '+'</p> <p>balancing mark is dependent on the correct formulae but  <b>ALLOW</b> 1 mark for a balanced equation with a minor error in subscripts / formulae            eg <math>\text{Mg} + 2\text{HCL} \rightarrow \text{Mgc}_2 + \text{H}_2</math></p>

21	(b)*	<p>Please refer to the marking instructions on page 4 of this mark scheme for guidance on how to mark this question.</p> <p><b>Level 3 (5–6 marks)</b> Analyses the results (in relation to <u>both</u> volume of acid &amp; mass of magnesium) to show that they do not support the prediction. <b>AND</b> explains the results using the reacting particle model.</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><b>Level 2 (3–4 marks)</b> Analyses the results (in relation to <u>both</u> volume of acid &amp; mass of magnesium) to show that they do not support the prediction OR sees that (both) predictions are incorrect and uses the data to show that only concentration affects reaction time <b>AND</b> explains the results using the reacting particle mode Uses the reacting particle model in terms of more collisions rather than frequency of collisions.</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><b>Level 1 (1–2 marks)</b> Analyses the results to show one of the predictions to be incorrect <b>OR</b> Uses the reacting particle model in terms of more collisions rather than frequency of collisions.</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>	6	<p>3 x 2.2 3 x 3.2b</p>	<p><b>AO3.2b Analyse information and ideas to draw conclusions.</b></p> <ul style="list-style-type: none"> <li>• results show as volume decreases reaction time does not change so reaction time does not change</li> <li>• results show that as mass of magnesium increases reaction time does not change</li> <li>• reaction in experiment 3 is faster / has a shorter reaction time, than experiment 2</li> </ul> <p><b>AO2.2 Apply knowledge and understanding of scientific enquiry, techniques and procedures.</b></p> <ul style="list-style-type: none"> <li>• concentration is higher in experiment 3</li> <li>• acid particles are more crowded in experiment 3 / acid particles are closer together / more acid particles per unit volume / more acid particles per cm<sup>3</sup> / more acid particles in the same space</li> <li>• more (successful) collisions per second / collisions more often / increased collision frequency / more chance of a collision</li> </ul> <p><b>IGNORE</b> references to 'faster' collisions</p>
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			<b>0 marks</b> <i>No response or no response worthy of credit.</i>			
21	(c)		<b>Any two from:</b> <b>Cooling the acid:</b> <ul style="list-style-type: none"> <li>idea that acid particles move slower / particles have less energy ✓</li> <li>idea of decreased collision frequency ✓</li> <li>idea of less successful collisions / collisions are less energetic ✓</li> </ul> <b>AND</b> <b>Predicted reaction time</b> – Any time more than 30s ✓	<b>3</b>	<b>3 x 2.2</b>	<b>ALLOW</b> particles don't move as much <b>ALLOW</b> 'less (unspecified) <b>kinetic</b> energy' <b>IGNORE</b> 'less energy' unless linked to particles
	(d)		(As reactants are used up) concentration of reactants decreases / particles of reactants become less crowded / less reactant particles per unit volume ✓  (so) collision frequency is less / less collisions per second ✓	<b>2</b>	<b>1.2</b>	Must have idea of concentration  <b>IGNORE</b> references to fewer particles/collisions, only mark credit-worthy responses



Question		Answer	Marks	AO element	Guidance
22	(a)	<p><b>Any two from:</b></p> <p>(Kevlar®) has a <u>low(er) density</u> / is (more) lightweight (than steel) ✓ so it is easier to wear or carry / more comfortable to wear ✓</p> <p><b>OR</b></p> <p>(Kevlar®) is strong(er) ✓ so it is less likely to be penetrated (by a bullet) ✓</p> <p><b>OR</b></p> <p>(Kevlar®) is (more) flexible ✓ so it is easier to wear / more comfortable to wear / idea that it allows movement more easily ✓</p> <p><b>OR</b></p> <p>(Kevlar®) does not corrode / does not rust ✓ so it will last longer ✓</p>	4	3.2b	<p><b>Explanation must be linked to description</b></p> <p><b>ALLOW</b> 'light / lighter' only if supported by comparative data <b>ALLOW</b> idea that person can move more easily or more quickly</p> <p><b>ALLOW</b> idea that (Kevlar®) can withstand a greater impact / is less easily damaged / is more resistant to wear <b>IGNORE</b> just the idea that (Kevlar®) is better at keeping you safe</p> <p><b>ALLOW</b> idea that the vest can be worn in all weathers</p>
	(b)	(Condensation) polymer ✓	1	1.1	<p><b>ALLOW</b> polyamide / polypeptide <b>DO NOT ALLOW</b> addition polymer <b>DO NOT ALLOW</b> chain</p>
	(c)	(i)			
		<p><b>FIRST CHECK THE ANSWER ON ANSWER LINE</b> <b>If answer = 100 award 3 marks</b></p> <p>Round each number to 1 significant figure: Silicon dioxide nanoparticle 20 nm ✓ Silicon atom 0.2 nm ✓</p> <p>Number of times larger <math>\cong 20/0.2 = 100</math> ✓</p>	3	2.2	<p><b>ALLOW</b> <math>(18 \div 0.22 =)</math> 81.8 / 82 / 80 for 1 mark if no other mark awarded <b>ALLOW</b> <math>(18 \div 0.2 =)</math> 90 for 2 marks if no other mark awarded</p>

Question			Answer	Marks	AO element	Guidance
22	(c)	(ii)	<p>(Silicon dioxide) nanoparticles have a greater surface area (to volume ratio than powder) / ORA ✓</p> <p>Idea that chemical reactions take place on the surface of a catalyst ✓</p> <p>Idea that there will be more (frequent) collisions / the rate of reaction will be faster ✓</p>	3	<p>1 x 2.1</p> <p>2 x 1.1</p>	<p><b>ALLOW</b> more active sites / idea that there are more places for the reaction to occur on</p> <p><b>IGNORE</b> idea that there is more area of catalyst to react with</p>

Question		Answer	Marks	AO element	Guidance
23	(a)	<p>CO<sub>2</sub> emissions (in the UK) have decreased (from 1993 to 2013 / from 2006) ✓</p> <p>Global sea levels have risen (from 1993 to 2013) ✓</p> <p>(Therefore) data suggests that CO<sub>2</sub> emissions are not the (only) cause of rising sea levels / Idea that factors other than CO<sub>2</sub> emissions contribute to rising sea levels / data does not support a link (between human activity and climate change) ✓</p>	3	3.1b	<p><b>ALLOW</b> idea that there is a negative correlation between CO<sub>2</sub> emissions and global sea levels / CO<sub>2</sub> emissions and global sea levels are inversely proportional <b>for 2 marks</b></p> <p><b>ALLOW</b> idea that sea levels were still rising when CO<sub>2</sub> emissions were decreasing <b>for 2 marks</b></p> <p><b>ALLOW</b> idea that the data does not completely support a link <b>ALLOW</b> idea that there is a mismatch between the data, ie one is UK but one is global</p>
	(b)	<p><b>Any two from:</b></p> <p>Idea that CO<sub>2</sub> emissions (from burning fossil fuels) are only from the UK and not a global figure ✓</p> <p>Global CO<sub>2</sub> emissions could be increasing ✓</p> <p>Idea that CO<sub>2</sub> emissions from other sources (not just burning fossil fuels) should be considered ✓</p> <p>Idea that there is a lag between CO<sub>2</sub> emissions impacting on global sea levels ✓</p>	2	3.2a	<p><b>ALLOW</b> idea that different countries produce different CO<sub>2</sub> emissions <b>ALLOW</b> idea that emissions from one country will not have a large impact on global CO<sub>2</sub> levels</p> <p><b>IGNORE</b> idea that other factors may affect global sea levels <b>IGNORE</b> idea that there are other greenhouse gases</p>

Question			Answer	Marks	AO element	Guidance
23	(c)	(i)	<p><b>Any one from:</b></p> <p>Idea of melting ice caps / melting glaciers / melting sea ice ✓</p> <p>Altered weather patterns ✓</p>	1	1.1	<p><b>IGNORE</b> ‘melting ice’</p> <p><b>ALLOW</b> specific examples or effects of altered weather patterns eg drought in some places or flooding in others</p> <p><b>ALLOW</b> specific effects of rising sea levels eg coastal erosion / flooding of low lying land</p> <p><b>IGNORE</b> rising temperatures</p>
		(ii)	<p><b>Any one from:</b></p> <p>Reduce consumption of fossil fuels ✓</p> <p>Use biofuels ✓</p> <p>Use renewable energy sources ✓</p> <p>Stop carbon dioxide escaping when fuels are used ✓</p> <p>Plant more trees / reduce deforestation / AW ✓</p>	1	1.1	<p><b>ALLOW</b> specific examples eg car share / cycle to work / use public transport / use electric cars / don’t leave appliances on standby</p> <p><b>ALLOW</b> specific renewable energy sources eg wind / solar energy / tidal</p> <p><b>IGNORE</b> use carbon neutral energy sources <b>ALLOW</b> use carbon capture (and storage)</p>

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