H

GCSE (9–1)

Chemistry A

(Gateway Science)

J248/04: Paper 4 (Higher 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.

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).

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

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.

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

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

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

Question			Answer	Marks	AO element	Guidance
17	(a)		CO_2 emissions (in the UK) have decreased (from 1993 to 2013 / from 2006) ✓ Global sea levels have risen (from 1993 to 2013) ✓ (Therefore) data suggests that CO_2 emissions are not the (only) cause of rising sea levels / Idea that factors other than CO_2 emissions contribute to rising sea levels / data does not support a link (between human activity and climate change) ✓	3	3.1b	**ALLOW** idea that there is a negative correlation between CO_2 emissions and global sea levels / CO_2 emissions and global sea levels are inversely proportional **for 2 marks** **ALLOW** idea that sea levels were still rising when CO_2 emissions were decreasing **for 2 marks** **ALLOW** idea that the data does not completely support a link **ALLOW** idea that there is a mismatch between the data, ie one is UK but one is global
	(b)		**Any two from:** Idea that CO_2 emissions (from burning fossil fuels) are only from the UK and not a global figure ✓ Global CO_2 emissions could be increasing ✓ Idea that CO_2 emissions from other sources (not just burning fossil fuels) should be considered ✓ Idea that there is a lag between CO_2 emissions impacting on global sea levels ✓	2	3.2a	**ALLOW** idea that different countries produce different CO_2 emissions **ALLOW** idea that emissions from one country will not have a large impact on global CO_2 levels **IGNORE** idea that other factors may affect global sea levels **IGNORE** idea that there are other greenhouse gases

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

Question			Answer	Marks	AO element	Guidance
18	(a)		$N_2 + 3H_2 \rightleftharpoons 2NH_3$ Formulae ✓ Balancing ✓	2	2.2	**ALLOW** any correct multiple, including fractions **DO NOT ALLOW** and / & instead of '+' balancing mark is dependent on the correct formulae but **ALLOW** = / $\rightarrow$ instead of $\rightleftharpoons$ **ALLOW** 1 mark for a balanced equation with a minor error in subscripts / formulae eg $N_2 + 3H2 \rightleftharpoons 2Nh_3$
	(b)	(i)	Increases / AW ✓	1	1.1	
	(b)	(ii)	(No) (because) higher temperature favours endothermic reaction / backward reaction / ORA ✓ (so) equilibrium shifts to left hand side / yield of ammonia is reduced / ORA ✓	2	2.1	**Marks are for explanation** **ALLOW** idea that the yield does not increase, in correct context References to reduced yield must not be in the context of rate
	(c)		**Any two from:** Idea that rate of reaction will be slower ✓ As there will be less frequent collisions / less collisions per second / particles collide less often ✓ Idea that yield of ammonia will be less ✓ (Lower pressure) favours backward reaction / equilibrium shifts to left hand side / ORA ✓ As there are fewer (gaseous) molecules on right hand side / ORA ✓	2	2.1	 **ALLOW** idea that reaction will take longer time **IGNORE** idea that the reaction will not be at equilibrium

Question			Answer	Marks	AO element	Guidance
	(d)	(i)	Repeat the titration until concordant results are obtained ✓ Repeat the experiment without the indicator ✓	2	3.3b	**ALLOW** note how much sulfuric acid is needed to neutralise the ammonia **ALLOW** idea of using (activated) charcoal to remove the indicator **BUT** **IGNORE** idea of just removing indicator before crystallising **ALLOW** idea of doing a rough titration and then repeating without indicator **for 2 marks**
		(ii)	Volumes of solution are too large for titration method / large volumes of liquid need to be heated and then allowed to crystallise ✓	1	1.1	**ALLOW** idea that industrial method is on a much larger scale / ORA **ALLOW** titration is a batch process / not a continuous process **ALLOW** idea that industry wants the reaction to be continually occurring **IGNORE** idea that it takes too long to do on a large scale

Question			Answer	Marks	AO element	Guidance
19	(a)		$Mg + 2HCl \rightarrow MgCl_2 + H_2$ Formulae ✓ Balancing ✓	2	2x 2.2	**ALLOW** any correct multiple, including fractions **ALLOW** = / ⇌ 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 Mg + 2HCL → $Mgcl_2$ + H2 **IGNORE** state symbols

Question	Answer	Marks	AO element	Guidance
(b)*	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 results to describe that the results in relation to the volume of acid DO NOT support the prediction but that the results in relation to the concentration of the acid DO support the prediction with reference to experimental data (that includes fair testing)** **AND** **explains the results in detail using the reacting particle model, using the idea of collision frequency, that the greater the concentration the faster the reaction rate.** *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 results to describe that the results in relation to the volume of acid DO NOT support the prediction AND that the results in relation to the concentration of the acid DO support the prediction with reference to experimental data** **AND** **explains the results using the reacting particle model, using idea of more collisions (rather than collision frequency) that the greater the concentration the faster the reaction rate.** *There is a line of reasoning presented with some structure. The information presented is relevant and supported by some evidence.*	6	3 x 3.2b 3 x 2.2	**AO3.2b Analyse information and ideas to draw conclusions.** **VOLUME** To include fair testing, candidates should compare EXPERIMENTS 1 & 2 **CONCENTRATION** To include fair testing, candidates should compare EXPERIMENTS 2 & 3 • results (in experiments 1 & 2) show as volume decreases reaction time does not change so reaction rate does not change • results show that as concentration increases reaction time gets less so reaction rate gets faster • the reaction in experiment 3 is faster, or has a shorter reaction time, than experiment 2 **AO2.2 Apply knowledge and understanding of scientific enquiry, techniques and procedures.** • concentration is higher in experiment 3 (than experiment 2) • acid particles are more crowded in experiment 3 / acid particles are closer together / more acid particles per unit volume / more acid particles per cm^3 / more acid particles in the same space • more (successful) collisions per second / collisions more often / increased collision frequency / more chance of a collision **IGNORE** references to 'faster' collisions **NB Correct points may be credited from annotation on the results table**

Question			Answer	Marks	AO element	Guidance
			Level 1 (1–2 marks) **Analyses the results to describe that the results in relation to the volume of acid DO NOT support the prediction** **<u>OR</u>** **analyses the results to describe that the results in relation to the concentration of the acid DO support the prediction** **<u>OR</u>** **explains using the reacting particle model, using idea of more collisions (rather than collision frequency) that the greater the concentration the faster the reaction rate.** *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.*			
	(c)		**Any two from:** **Heating the acid:** • idea that acid particles move faster / particles have more energy ✓ • idea of increased collision frequency ✓ • idea of more successful collisions / collisions are more energetic ✓ **AND** **Predicted reaction time** – Any time less than 30s ✓	**3**	**3 x 2.2**	**ALLOW** the reaction time will decrease / the reaction time will be less than 30 seconds **DO NOT ALLOW** reaction time increases **DO NOT ALLOW** faster reaction time

Question	Answer	Marks	AO element	Guidance
(d)	**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 1.67 x 10^{-3} (g/s) award 3 marks** $8.33 \times 10^{-4} \times 240 = 0.19992 = 0.2$ or $100 \times 2.00 \times 10^{-3} = 0.2$ or $50 \times 4.00 \times 10^{-3} = 0.2$ ✓ $0.2 \div 120 =$ 0.00166666… or $0.2 \div 120 = 0.00167$ ✓ $= 1.67 \times 10^{-3}$ (g/s) ✓ **OR** $8.33 \times 10^{-4} \times 2$ ✓ = 0.001666 or 0.00167 ✓ $= 1.67 \times 10^{-3}$ (g/s) ✓	3	**2 x 2.2** **1.2**	**ALLOW** 1.66 x 10^{-3} / 1.7 x 10^{-3} for 2 marks **IGNORE** 0.0016 / 1.6 x 10^{-3} **ALLOW** 1.66 x 10^{-3} / 1.7 x 10^{-3} for 2 marks **IGNORE** 0.0016 / 1.6 x 10^{-3} **ALLOW ECF** from incorrect calculation for 3 sig fig and standard form mark

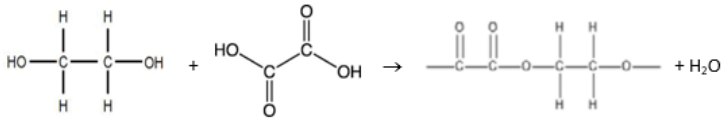
<table>
<tr><th colspan="3">Question</th><th>Answer</th><th>Marks</th><th>AO element</th><th>Guidance</th></tr>
<tr><td>20</td><td>(a)</td><td></td><td>Any two from:
(Potassium) reacts violently / sparks / ignites / explodes✓
floats / moves around on surface of water ✓
moves quickly (on water) ✓
lilac flame ✓
melts (into a ball) ✓
dissolves ✓
(hydrogen gas ignites with) a squeaky pop ✓</td><td>2</td><td>2.2</td><td>ALLOW (potassium) disappears / gets smaller</td></tr>
<tr><td></td><td>(b)</td><td></td><td>Any two from:
(Down Group 1) <u>outer</u> electron or <u>outer</u> shell gets further from the nucleus / more shielding / atomic radius increases / more electron shells / ORA ✓

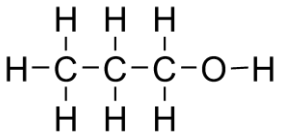
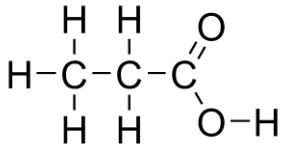
Idea of less attraction between nucleus and <u>outer</u> shell electron ✓

<u>Outer</u> shell electron is lost more easily ✓</td><td>2</td><td>1.1</td><td>ALLOW <u>outer</u> electron in potassium is further from the nucleus than in lithium / ORA
IGNORE potassium has more electrons (than lithium)

DO NOT allow idea that outer electron is lost more quickly / AW</td></tr>
<tr><td></td><td>(c)</td><td></td><td>
<table>
<tr><th>Element</th><th>Formula</th><th>Colour</th><th>State at room temperature</th></tr>
<tr><td>Fluorine</td><td>F_2</td><td>pale yellow</td><td>gas</td></tr>
<tr><td>Chlorine</td><td>Cl_2</td><td>green ✓</td><td>gas ✓</td></tr>
<tr><td>Bromine</td><td>Br_2</td><td>brown</td><td>liquid</td></tr>
<tr><td>Iodine</td><td>I_2</td><td>grey</td><td>solid ✓</td></tr>
</table>
</td><td>3</td><td>1.1</td><td></td></tr>
</table>

Question			Answer	Marks	AO element	Guidance
	(d)		(Fluorine has) weak intermolecular forces / weak forces between molecules ✓ which only require a small amount of energy to break / which are easy to break ✓	**2**	**1.1**	**ALLOW** weak intermolecular bonds **DO NOT ALLOW** references to covalent bonds between molecules **OR** weak forces between atoms – scores 0
	(e)		(Group 0 elements) have a full / complete outer shell ✓ Idea that they have no tendency to lose or gain electrons ✓	**2**	**1.1**	**ALLOW** 8 electrons in outer shell **IGNORE** idea that they have no tendency to react unless linked to gaining a full outer shell (of electrons)

Question			Answer	Marks	AO element	Guidance
21	(a)		Idea of swapping the position of boiling tube **X** and the boiling tube of limewater ✓ Idea that any liquid that condenses in boiling tube **X** must have come from the burning methane or not from the limewater ✓	**2**	**3.3b**	**ALLOW** idea that water condenses before the limewater is reached **ALLOW** idea of carrying out 2 experiments, one to test for carbon dioxide and one to test for water **for 2 marks**
	(b)		Type of polymerisation – condensation (polymerisation) ✓ Correct choice of ethane-1,2-diol and ethanedioic acid ✓ Equation:  Correct ester (link) formed ✓ Water molecule eliminated ✓	**4**	**1 x 1.1** **1 x 3.1a** **2 x 2.1**	**ALLOW** mark for correct choice of monomers from correct reactant structures in an equation **ALLOW** mark for 'water' from an equation, even if incorrect
	(c)	**(i)**	4 / four ✓	**1**	**1.1**	
		(i)	Amino acids ✓	**1**	**1.1**	

Question			Answer	Marks	AO element	Guidance
	(d)	(i)	Carboxylic acids ✓	1	1.1	**IGNORE** carboxyl group
		(ii)	Alcohol **X**  ✓ Compound **Y**  ✓	2	2.1	**ALL** covalent bonds must be shown in both displayed formulae **BUT** **ALLOW** 1 mark if both displayed formulae are correct, but show '-OH' without covalent bond

Question			Answer	Marks	AO element	Guidance
22	(a)		**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 2.24 / 2.243 / 2.2 (dm^3) award 2 marks**	**2**	**2.2**	
			Moles of ammonium chloride = 5.00 ÷ 53.5 or 0.0935 ✓			**ALLOW** 0.09 / 0.094
			Volume of ammonia = moles x 24 = 0.0935 x 24 = 2.24 / 2.243 / 2.2 (dm^3) ✓			**ALLOW ECF** from moles of ammonium chloride **if first mark not awarded**
			OR			
			2 x 53.5 = 107g ammonium chloride produces 2 x 24 = 48 dm^3 ammonia ✓			
			So 5.00g of ammonium chloride produces $\frac{5 \times 2 \times 24}{2 \times 53.5}$ = 2.24 / 2.243 / 2.2 (dm^3) ammonia ✓			**ALLOW** 2.16 (ECF from 0.09)
	(b)	**(i)**	Moles of acid / HC*l* = 35.0 ÷ 1000 x 0.075 = 0.002625 / 0.0026 / 2.625×10^{-3} / 2.6×10^{-3} ✓	**3**	**2.2**	
			Moles of alkali / NaOH = 25.0 ÷ 1000 x 0.100 = 0.0025 / 2.5×10^{-3} ✓			**ALLOW** 1 mark for moles of acid = 2.625 **and** moles of alkali = 2.5 (ie use of cm^3 instead of dm^3)
			The acid is in excess ✓			**Third mark dependent on clear attempt at a calculation of moles of acid and alkali** **ALLOW ECF** from calculated moles of acid and alkali

Question			Answer	Marks	AO element	Guidance
		(ii)	Correct choice of concordant results – 36.3 and 36.2 ✓ Mean = (36.30 + 36.20) ÷ 2 = 36.25 (cm^3) ✓	2	2.2	**ALLOW** 1 mark for **ECF** from any incorrect choice of concordant values eg 35.875 / 35.88 / 35.9 (cm^3) if all values are used
	(c)		**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 0.3968 / 0.397 / 0.40 (mol / dm^3) award 4 marks** Moles of acid = $\frac{0.200 \times 24.80}{1000}$ **or** 0.00496 / 4.96 x 10^{-3} ✓ Moles of KOH = 2 x 0.00496 **or** 0.00992 / 9.92 x 10^{-3} ✓ Concentration of KOH = $\frac{0.00992}{25.0}$ x 1000 ✓ = 0.3968 / 0.397 / 0.40 (mol / dm^3) ✓	4	2.2	**ALLOW** 0.005 / 5.00 x 10^{-3} **ALLOW** clear indication that the ratio of KOH:acid is 2:1 **ALLOW** 0.01 / 1.00 x 10^{-2} **ALLOW** ecf from incorrect moles of acid ie 2 x moles of acid **ALLOW** ecf from incorrect moles of KOH eg $\frac{0.00496}{25.0}$ x 1000 = 0.1984 ie 0.1984 would **score 3 marks**

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