

GCSE (9-1)

Chemistry A

(Gateway Science)

J248/03: Paper 3 (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.

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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).

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.

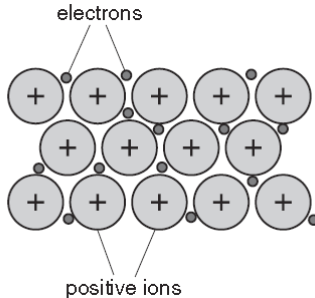
The breakdown of Assessment Objectives for GCSE (9-1) in Combined Science A:

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

Question			Answer	Marks	AO element	Guidance
16	(a)	(i)	Positive (metal) ions or cations (in a lattice structure) ✓ Surrounded by sea of or delocalised electrons ✓	2	1.1	Any reference to ionic or covalent bonding or IMF scores 0 ALLOW a labelled diagram  If diagram must be at least one electron in the body of the ions Diagram must show close packed metal ions, in a regular arrangement ALLOW - / e / e⁻ / dots for electrons ALLOW Circles with + or circles labelled ions IGNORE free electrons If e or e⁻ used don't need labelling
		(ii)	Idea that layers or rows or sheets (of particles) slide over each other ✓	1	1.1	IGNORE layers can bend IGNORE IMF
		(iii)	Has electrons ✓ (Electrons) can move / that can carry the charge ✓ BUT Delocalised electrons scores 2 marks	2	1.1	DO NOT ALLOW free ions – scores 0 IGNORE free (electrons) for idea of movement

Question			Answer	Marks	AO element	Guidance
	(b)		Low density and idea that aircraft is lightweight / isn't too heavy to fly / less weight to carry / AW ✓ High strength and idea that aircraft is less likely to be damaged ✓	2	3.2b	DO NOT ALLOW light / lighter for low density but ALLOW so aircraft is light or lighter Answers must give property and explanation for marks BUT ALLOW 1 mark for low density and high strength / strongest if no or only one explanation given
	(c)	(i)	(Percentage of lithium =) $(2 \div 10) \times 100 = 20(\%)$ ✓	1	3.1a	
		(ii)	Idea that alloy B is only 2.2% lithium / Idea that alloy B is 2.2% lithium but the diagram has 20% lithium / Idea that the % of lithium in the alloy is much smaller than in the diagram / there should be 100 aluminium atoms (and 2 lithium atoms) ✓	1	3.2a	ALLOW ECF from incorrect percentage in (c)(i) ALLOW should be more Al atoms / 17.8% too large IGNORE references to the relative sizes of the atoms

Question			Answer	Marks	AO element	Guidance
17	(a)		Could be breathed in / Idea of absorbed by skin / Idea of absorbed into bloodstream / Take a long time to break down in the environment ✓	1	2.1	ALLOW cannot see so may leave (areas of) skin unprotected ALLOW idea that we don't know the long term risks IGNORE idea that they are not fully understood / there could be side effects / idea that they may react with or irritate skin / harmful to humans
	(b)		FIRST CHECK THE ANSWER ON ANSWER LINE If answer = 0.12 OR 0.12:1 OR 1:8.3 award 4 marks Surface area = $6 \times 50^2 = 15000$ ✓ Volume = $50^3 = 125000$ ✓ Surface area / volume ratio = $15000 \div 125000$ ✓ = 0.12 or 0.12:1 or 1:8.3 ✓	4	3 x 2.2 1.2	Units not needed ALLOW surface area = $1.5 \times 10^4 \text{ nm}^2$ ALLOW volume = $1.25 \times 10^5 \text{ nm}^3$ ALLOW ECF from incorrect surface area and/or volume ALLOW any simplified ratio consistent with 0.12:1 eg 3:25 or 1.5:12.5 for 4 marks DO NOT ALLOW ratio wrong way round eg 1:0.12
	(c)	(i)	Nanoparticles have diameter between 1 - 100 (nm) / idea that (diameter of) DNA is more than 1 (nm) but less than 100 (nm) ✓ Water (molecule) is too small / 0.27 (nm) is less than 1 (nm) / idea that 0.27 (nm) is not in range 1 – 100 (nm) ✓	2	1.1	ALLOW has at least one dimension on the nanoscale

Question			Answer	Marks	AO element	Guidance
		(ii)	FIRST CHECK THE ANSWER ON ANSWER LINE If answer = 3100 award 2 marks $100000 \div 32 \checkmark$ $= 3100$ (2 significant figures) $\checkmark$	2	2.2	ALLOW 3125 for 1 mark ALLOW 0.00032 for 1 mark (correct sig figs from incorrect working out, ie $32 \div 100000$)

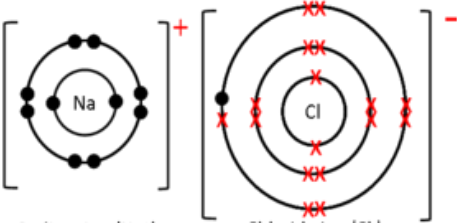
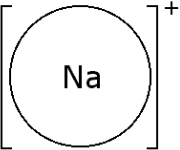
Question			Answer	Marks	AO element	Guidance
18	(a)	(i)	Methanol ✓ (because it has the) lowest boiling point ✓	2	3.2b	IGNORE (because it has the) lowest melting point
		(ii)	Particles (are close together in a liquid and) move further apart in a gas ✓	1	1.1	Answer must be comparative ALLOW idea that arrangement of particles becomes less regular or more random IGNORE the idea that movement increases
		(iii)	Particles move more quickly (in all directions) in a gas ✓	1	1.1	Answer must be comparative IGNORE particles have more (kinetic) energy IGNORE the idea that movement increases
		(iv)	Fractionating column ✓ Large surface area ✓	2	3.3b 1.2	ALLOW fractional (distillation) column IGNORE distillation / fractional distiller
	(b)		More energy is given out during bond making than is taking in during bond breaking / AW ✓	1	1.1	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
	(c)	(i)	FIRST CHECK THE ANSWER ON ANSWER LINE If answer = (+)3057 (kJ/mol) award 2 marks (413 x 3) + (358) + (464) + (2 x 498) ✓ = 3057 (kJ/mol) ✓	2	2.2	IGNORE + or - sign
		(ii)	FIRST CHECK THE ANSWER ON ANSWER LINE If answer = (-)3466 (kJ/mol) award 2 marks (805 x 2) + (464 x 4) ✓ = 3466 (kJ/mol) ✓	2	2.2	IGNORE + or - sign
		(iii)	3057 – 3466 = -409 (kJ/mol) ✓	1	2.2	ALLOW ecf from parts (i) and (ii) DO NOT ALLOW +409

Question			Answer	Marks	AO element	Guidance												
19	(a)	(i)	C ✓ Low density and good electrical conductor ✓	2	3.2a 1.1	Second mark is dependent on correct choice of C BOTH properties required for second mark IGNORE good conductor DO NOT ALLOW light / lighter for low density												
		(ii)	Idea of a feature of a substance that can be observed or measured ✓	1	1.1	ALLOW a specific example eg the appearance of something or the state (of matter) or melting point / boiling point IGNORE idea of a property that is reversible												
	(b)		Dissolve gas or oxide in water / make a solution of the oxide ✓ Test with universal indicator (paper) ✓ (universal indicator) would turn blue / pH greater than 7 ✓	3	3.3a	ALLOW shake gas or oxide with water ALLOW use a pH meter / pH probe ALLOW test with (damp) red litmus (paper) ALLOW (damp red litmus paper) turns blue												
	(c)	(i)	<table border="1"><thead><tr><th>Isotope</th><th>Number of protons</th><th>Number of neutrons</th><th>Number of electrons</th></tr></thead><tbody><tr><td>Chlorine-35</td><td>17</td><td>18</td><td>17</td></tr><tr><td>Chlorine-37</td><td>17</td><td>20</td><td>17</td></tr></tbody></table> ✓ ✓	Isotope	Number of protons	Number of neutrons	Number of electrons	Chlorine-35	17	18	17	Chlorine-37	17	20	17	2	1.1	
Isotope	Number of protons	Number of neutrons	Number of electrons															
Chlorine-35	17	18	17															
Chlorine-37	17	20	17															

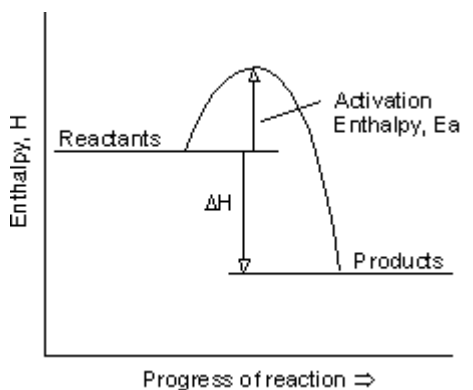
Question			Answer	Marks	AO element	Guidance
		(ii)	$\text{Cl}_2 + 2\text{e}^- \rightarrow 2\text{Cl}^-$ ✓	1	2.1	ALLOW $\text{Cl}_2 \rightarrow 2\text{Cl}^- - 2\text{e}^-$ ALLOW any correct multiple, including fractions ALLOW $= / \rightleftharpoons$ instead of $\rightarrow$ DO NOT ALLOW and / & instead of '+' balancing mark is dependent on the correct formulae but
		(iii)	$\text{Ba}^{2+}(\text{aq}) + \text{SO}_4^{2-}(\text{aq}) \rightarrow \text{BaSO}_4(\text{s})$ Equation ✓ State symbols ✓	2	2.1	ALLOW any correct multiple, including fractions ALLOW $= / \rightleftharpoons$ instead of $\rightarrow$ DO NOT ALLOW and / & instead of '+' Mark for state symbols is dependent on correct species ALLOW a full balanced ionic equation $\text{Ba}^{2+}(\text{aq}) + 2\text{Cl}^-(\text{aq}) + 2\text{Na}^+(\text{aq}) + \text{SO}_4^{2-}(\text{aq}) \rightarrow \text{BaSO}_4(\text{s}) + 2\text{Na}^+(\text{aq}) + 2\text{Cl}^-(\text{aq})$

Question			Answer	Marks	AO element	Guidance
20	(a)	(i)	x-axis labelled volume of hydrochloric acid in cm ³ and y-axis labelled pH ✓ All points plotted correctly ✓ Line of best fit drawn ✓	3	2.2 x 2 1.2	 ALLOW ±½ square Must be identifiable as a titration curve
		(ii)	Answer ± 0.1cm ³ of their own graph ✓	1	2.2	Scores 0 if no line of best fit in (a)(i)
		(iii)	Decreases ✓	1	3.1a	ALLOW diluted
		(iv)	H ⁺ + OH ⁻ → H ₂ O ✓	1	1.1	ALLOW correct multiples IGNORE state symbols
	(b)		Strong acids are fully ionised or completely dissociated (in aqueous solution) ✓ Weak acids are partially ionised or not completely dissociated (in aqueous solution) ✓	2	1.1	ALLOW all molecules release H ⁺ ions ALLOW HCl → H ⁺ + Cl ⁻ DO NOT ALLOW strong acids have many H ⁺ ions / strong acids have a high concentration of H ⁺ ions IGNORE strong acids are more ionised / dissociated ALLOW not all molecules release H ⁺ ions ALLOW CH ₃ COOH ⇌ CH ₃ COO ⁻ + H ⁺ DO NOT ALLOW weak acids have few H ⁺ ions / weak acids have a low concentration of H ⁺ ions
	(c)	(i)	FIRST CHECK THE ANSWER ON ANSWER LINE If answer = pH 4 award 2 marks Concentration of H ⁺ decreases by factor of 10, the pH increases by 1 ✓ Factor of 100 = 10 x 10 so pH increases by 2 pH value = 4 ✓	2	 2.1 2.2	

Question			Answer	Marks	AO element	Guidance
		(ii)	$\text{HNO}_3 + \text{NaOH} \rightarrow \text{NaNO}_3 + \text{H}_2\text{O}$ ✓	1	1.1	ALLOW any correct multiple, including fractions ALLOW = / $\rightleftharpoons$ instead of $\rightarrow$ DO NOT ALLOW and / & instead of '+' IGNORE state symbols
		(iii)	Any two from: Evaporate water (slowly) / heat the solution ✓ Idea of forming a saturated solution ✓ Idea of crystallisation ✓ Cool solution (slowly) ✓ Idea of drying in a warm oven / air drying / leave on filter paper to dry ✓	2	3.3a	DO NOT ALLOW idea of boiling the solution IGNORE just 'crystals should be dried'

Question	Answer	Marks	AO element	Guidance
21 (a) (i)	Any two from: Size of atoms or ions is not accurate ✓ Idea that atoms or ions are held together by forces not physical bonds ✓ Idea that it show the atoms or ions too far apart ✓ There are not really 'sticks' holding the atoms or ions together ✓ Charges on ions are not shown ✓	2	3.1b	ALLOW doesn't show relative size of atoms or ions IGNORE idea that you cannot see the forces between the atoms / ions DO NOT ALLOW charges on atoms are not shown
	(ii)  Correct sodium ion / 2.8 OR empty outer shell ✓ ie  Correct chloride ion / 2.8.8 OR correct chloride ion showing full outer shell only ✓	2	2.1	Two correct electronic structures but no charges award one mark Two correct charges with incorrect electronic structure award one mark The ionic charges must not be shown in the nucleus Award 0 marks for structures with shared electrons One electronic structure must be labelled in some way to indicate which ion is which in order to score two marks. ALLOW answers showing the transfer of electrons providing the same electrons are not shown twice All electrons can be dots or crosses

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 ideas and applies knowledge to explain the formation of the products during the electrolysis of potassium bromide solution, including balanced half equations. <i>There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.</i> Level 2 (3–4 marks) Analyses ideas and applies knowledge to explain the formation of the products during the electrolysis of potassium bromide solution OR applies knowledge to write balanced half equations. <i>There is a line of reasoning presented with some structure. The information presented is relevant and supported by some evidence.</i> Level 1 (1–2 marks) Applies knowledge to identify the products formed at the electrodes OR applies knowledge to identify the ions present in the solution OR applies knowledge to identify which ions move to each electrode. <i>There is an attempt at a logical structure with a line of reasoning. The information is in the most part relevant.</i> 0 marks <i>No response or no response worthy of credit.</i>	6	2 x 1.1 2 x 2.1 2 x 3.2b	AO1.1 Knowledge of electrolysis - Negative electrode is cathode - Positive electrode is anode - Ions move to oppositely charged electrodes AO2.1 Apply knowledge and understanding of the electrolysis of salt solutions - Hydrogen ions are discharged more readily than potassium ions, so hydrogen is formed at the cathode - Bromide ions are discharged more readily than hydroxide ions, so bromine is formed at the anode - Cathode: $2\text{H}^+ + 2\text{e}^- \rightarrow \text{H}_2$ / $2\text{H}^+ \rightarrow \text{H}_2 - 2\text{e}^-$ - Anode: $2\text{Br}^- \rightarrow \text{Br}_2 + 2\text{e}^-$ / $2\text{Br}^- - 2\text{e}^- \rightarrow \text{Br}_2$ AO3.2b Analyse ideas about electrolysis to draw conclusions about the electrolysis of potassium bromide solution - Solution contains K^+ and Br^- ions from potassium bromide and H^+ and OH^- ions from water - Positive ions / K^+ and H^+ ions move to negative electrode - Negative ions / Br^- and OH^- ions move to positive electrode DO NOT ALLOW reference to bromine ions

Question			Answer	Marks	AO element	Guidance
22	(a)	(i)	 Correctly labelled axes ✓ Products shown below reactants ✓ Activation energy correctly labelled ✓ Energy change or ΔH correctly labelled ✓	4		1.2 ALLOW 'energy' for 'enthalpy' and 'time' for 'progress of reaction' 2.2 Reactants and products must be labelled (ALLOW formulae or names) 2.2 DO NOT ALLOW double headed arrow 2.2 DO NOT ALLOW double headed arrow
		(ii)	Carbon donates or gives or loses electrons (to the lead ions) / electrons are transferred from carbon (to lead ions) ✓	1	1.1	IGNORE carbon is oxidised IGNORE reference to lead oxide DO NOT ALLOW idea of transfer of electrons to oxygen / oxide ion
	(b)	(i)	$3\text{Pb} + 8\text{HNO}_3 \rightarrow 3\text{Pb}(\text{NO}_3)_2 + 2\text{NO} + 4\text{H}_2\text{O}$ Formulae ✓ Balancing ✓	2	1.1 2.2	ALLOW any correct multiple, including fractions ALLOW = / $\rightleftharpoons$ instead of $\rightarrow$ 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. $3\text{PB} + 8\text{HNO}_3 \rightarrow 3\text{Pb}(\text{NO}_3)_2 + 4\text{H}_2\text{O}$

Question			Answer	Marks	AO element	Guidance
		(ii)	FIRST CHECK THE ANSWER ON ANSWER LINE If answer = 0.10 award 4 marks M_r of $\text{Pb}(\text{NO}_3)_2 = 331.2$ or 207g of Pb would produce 331.2g of $\text{Pb}(\text{NO}_3)_2$ / 20.7g of Pb would produce 33.12g of $\text{Pb}(\text{NO}_3)_2$ ✓ Moles = mass $\div$ M_r / $33.1 \div 331.2$ ✓ = 0.09993961 ✓ = 0.10 (2 sig. figs) ✓ OR Ratio of Pb : $\text{Pb}(\text{NO}_3)_2$ is 3:3 / 1:1 ✓ RAM of Pb is 207 or 207.2 ✓ (so) 20.7g of Pb is 0.10 mol or 0.099903474 ✓ (and so) this will make 0.10 mol of $\text{Pb}(\text{NO}_3)_2$ ✓	4	3 x 2.2 1.2	ALLOW 331 ALLOW ECF from balanced equation in (i) ALLOW 3 marks for 0.1 (ie not 2 sig figs) ALLOW ECF from incorrect calculation for sig fig mark ALLOW ECF from balanced equation in (i) ALLOW ECF for calculation of mol of Pb from incorrect RAM

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