OCR
Oxford Cambridge and RSA

H

GCSE (9–1)

Chemisty B (Twenty First Century Science)

J258/04: Depth in chemistry (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

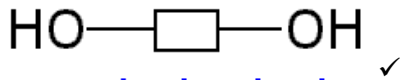
	Assessment Objective
AO1	**Demonstrate knowledge and understanding of scientific ideas and scientific techniques and procedures.**
AO1.1	Demonstrate knowledge and understanding of scientific ideas.
AO1.2	Demonstrate knowledge and understanding of scientific techniques and procedures.
AO2	**Apply knowledge 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	(a)		**Any three from:** more than one metal ion has green colour / orange colour / same colour ✓ A/green flame colour could be copper or zinc or iron ✓ B/orange-red flame colour is (probably) calcium / could be calcium or iron ✓ Iron can be many different colours (so difficult to identify) ✓ Difficult to tell the difference between some colours (by eye) / colours overlap ✓	3	2.2	**ALLOW** two metals linked to a colour/ 2 metals linked to A or B **IGNORE** it could be a mixture **IGNORE** not all ions are given for reference
	(b)	(i)	gives a result with acid and with silver nitrate / could be a carbonate or a chloride ✓	1	2.2	Result for carbonate is fizzes/CO_2 given off/limewater turns milky and silver nitrate result is white precipitate **ALLOW** correct formulae for ions e.g. CO_3^{2-} / Cl^- **IGNORE** 'halide' **DO NOT ALLOW** chlorine
		(ii)	A: copper and B calcium (no iron or zinc) ✓ chloride in both ✓ A (only) carbonate ✓	3	3.2b	**DO NOT ALLOW** chlorine **DO NOT ALLOW** carbonate mark if additional incorrect anions if more than 2 for A or 1 for B are given

	(c)		faster / gives a printout / distinct or matching lines / idea that spectrum is unique / does not rely on human eye / does not rely on observations / less (human) error / can identify a mixture of ions / more sensitive / does not rely on human judgment (of colour) ✓	**1**	**1.2**	**IGNORE** it is easier/more accurate/more reliable **ALLOW** gives amounts

Question			Answer	Marks	AO element	Guidance
2	(a)	(i)	volume = 8 ✓ surface area = 48 ✓ ratio = (48 ÷ 8) = 6 ✓	3	2.2	**ALLOW** ECF
		(ii)	nanoparticles have a higher surface area ✓ when the same volume is compared ✓	2	1.1	**ALLOW** 1 mark for 'They have a bigger surface area to volume ratio' **IGNORE** 'they are smaller'
	(b)	(i)	Nanoparticles are (very/much) small(er) ✓ Nanoparticles are smaller than holes / can <u>fit</u> through / metal particles are <u>too large</u> to pass through the holes ✓	2	1.1 2.1	**IGNORE** 'can go through holes'
		(ii)	**Any three from:** Some risks of nanoparticles are not known ✓ Risk is the same for both / (Risk is different because) socks use nanoparticles outside the body, cancer treatment they are inside ✓ Cancer is life threatening / can cause death / very serious disease ✓ Benefit for treating cancer greater / treating cancer is worth the risk / benefit outweighs risk ✓ Not having smelly feet is not important / not worth the risk / benefit does not outweigh risk ✓	3	3.1b	

Question			Answer	Marks	AO element	Guidance
3	(a)		H^+ ions (from the acid) give low pH / H^+ present at start/at 0 ✓ OH^- ions (from alkali) give high pH / OH^- present at the end / in excess after 25cm^3 alkali is added ✓ 25cm^3 is neutralisation / <u>increase</u> is neutralisation point / 25cm^3 shows change from acid to alkali / <u>increase</u> shows change from acid to alkali / (sudden) change from low pH to high pH ✓	3	2.1	**IGNORE** pH increases alone. **ALLOW** quoted values of pH1-3.5 to pH10.5-12.5
	(b)		Experiment uses 25.0 cm^3 sodium hydroxide (for neutralisation) / 20cm^3 is not neutral/still acidic ✓ idea that more volume (more than 20.0 cm^3) sodium hydroxide needed (than acid) ✓	2	2.1	

Question			Answer	Marks	AO element	Guidance
4	(a)		Polyester ✓	1	1.1	
	(b)	(i)	 ✓	1	1.2	**DO NOT ALLOW** –HO
		(ii)	water is given out during polymerisation / condensation reaction / water is taken in during break down ✓ one reaction is the reverse of another / one makes polymer (from monomers/molecules) the other breaks it down / water in and water out ✓	2	1.1	Note ' fig 4.2' is the breakdown of the polymer **DO NOT ALLOW** if addition is stated **ALLOW** breakdown is hydrolysis **ALLOW** 2 marks for the idea of water in and out
		(iii)	Contains COOH ✓ 'Di' because it contains two acid groups / two carboxyl group / acid group on both ends ✓	2	1.1	**ALLOW** description of COOH group e.g. carbon double bonded to an oxygen atom and an OH group **ALLOW** 'two carboxylic groups'
	(c)		**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 382 award 2 marks** RFM = ((6×12) + (4 × 16) + (1 × 8) = 144 ✓ 55000 ÷ 144 = 382 (nearest whole number) ✓	2	2.2	**ALLOW 1 mark** for 1964 (using Mr as 28) / 381.94… **ECF** 55000 ÷ RFM rounded correctly to a whole number

Question			Answer	Marks	AO element	Guidance
5	(a)		$CuCO_3 \rightarrow CuO$ ✓ $+ CO_2$ ✓	2	2.1	 Must be correctly balanced for 2 marks with no additional products
	(b)		**Any two from:** copper oxide ✓ malachite/copper carbonate ✓ carbon/soot/coke ✓	2	2.2	**ALLOW** correct formulae
	(c)	(i)	**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 9.8(g) award 3 marks** show rearrangement of equation mass of copper = theoretical yield ÷ 0.51 ✓ = 9.8(0392) ✓ = 9.8 (2 sig. figs) ✓	3	 2.2 1.2	 **ALLOW** 1 mark for incorrect answer with working correctly rounded to 2 sig figs
		(ii)	**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 48(%) award 2 marks** 2.4 / 5.0 ✓ x100 = 48 (%) ✓	2	2.2	 **ALLOW** 1 mark for 24.48979591…. (from 9.8 rather than 5.0)

		(iii)	**Any two from:** heat copper carbonate to constant mass / heat it for longer / heat to a higher temperature / heat more strongly ✓ make sure carbon is in excess / add more carbon ✓ heat for longer with carbon ✓ make sure all copper has sunk to the bottom / repeat shaking with water stage / recover more copper from water and/or impurities (e.g. by filtering) ✓ idea of minimising loss of product in transfer between stages/apparatus ✓	**2**	**3.3b**	 **ALLOW** coke for carbon **DO NOT ALLOW** evaporate/distil/boil off the water <u>then</u> filter

5	**(d)**		**Any three from:** No need to mine malachite ✓ Does not involve heating / no fuels needed / uses less energy ✓ Does not produce carbon dioxide/waste gas/greenhouse gases ✓ Supplies of ores are running out ✓ Biological methods involve use of acids (which may harm environment) / may cause leaching / may cause acids or metals to enter water courses ✓ Cannot meet demand using biological methods alone / cannot make enough / only small scale / too slow (to be viable) ✓ idea of using waste / is a recycling method / idea that bacteria remove a waste product/impurities/ possibly toxic substances (from the environment) ✓	**3**	**3.1b**	**ALLOW** reverse arguments throughout **IGNORE** bacteria increase carbon dioxide **IGNORE** eutrophication

Question			Answer	Marks	AO element	Guidance
6	(a)		exothermic means that heat or energy is given out/made / exothermic process speeds up rate of reaction ✓ process 1 does not need to be heated / keeps it at 60°C ✓ process 2 water evaporates (without external heat) / ammonium sulfate forms as dry powder ✓	3	1.1 2.2x2	
	(b)		evaporation ✓ filtration (and then evaporation) ✓	2	2.2	**IGNORE** crystallisation (in both) **DO NOT ALLOW** mention of distillation (in both)
	(c)		**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 56.9(%) award 3 marks** **Gives any two correct RFM from:** $(NH_4)_2CO_3$ = (2x14 + 8x1 + 12 + 3x16) / 96 $CaSO_4$ = (40.1 +32.1 + 4x16) / 136(.2) $(NH_4)_2SO_4$ = (2x14 + 8x1 +32.1+ 4x16) / 132(.1) ✓✓ Calculates atom economy correctly = 56.9 (%) ✓	3	2.2 1.2	**ALLOW** 2 marks for 232(.2) shown in working
	(d)	(i)	can continue without causing harm to the environment/without depleting resources / meeting current needs without compromising future generations / meeting both current and future needs ✓	1	1.1	

		(ii)	**Any two from:** Process 1 uses concentrated acids which cause a safety risk (to humans or the environment) ✓ Process 1 requires energy for heating / needs a higher temperature / process 2 requires energy for evaporation ✓ Process 1 and 2 have 100% atom economy / produce no waste / process 3 has a much lower atom economy / produces waste/produces calcium carbonate ✓ Calcium carbonate must be disposed of / may not have a use ✓	**2**	**2.2**	**IGNORE** 'needs energy' alone **IGNORE** 'kept at 60ºC' alone **ALLOW** processes with 100% atom economy are more sustainable than those which produce waste **IGNORE** references to yield
	(e)		**Any two from:** Batch is small scale / continuous is large scale ✓ (Batch used in labs because) does not need complex equipment / uses standard laboratory equipment / idea of quality controlled products ✓ (Continuous used in industry because) works all day and all night / no break in production / no need to keep heating up apparatus from cold / no need to clear vessels /automated / less need for human operators ✓	**2**	**1.1**	**ALLOW** reverse arguments **ALLOW** 'high demand' **IGNORE** specific formulation ideas **IGNORE** 'it is continuous' alone

Question			Answer	Marks	AO element	Guidance
	7*		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)** Identifies advantages and disadvantages of all three diagrams **AND** Describes features of an ideal diagram. *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)** Describes advantages and disadvantages of two or more diagrams. **OR** Describes advantages and disadvantage of one diagram and describes features of an ideal diagram. *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)** Identifies an advantage or disadvantage of all three diagrams. **OR** Describes a feature of an ideal diagram. *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.*	**6**	**2x 3.1a** **4x 1.1**	**AO1.1/AO3.1a Knowledge and understanding linked to the interpretation of the diagrams in question** Advantages and disadvantages of A • shows vibration of particles /shows it is a solid • does not show ions/charges/bonding/sizes/3D nature/does not is show 2 different particles/elements/ions / all particles the same Advantages and disadvantages of B • shows charges on ions / shows ions are different / shows why ions are attracted / shows (ionic) bonding/attraction / shows relative sizes / shows ratio (of ions) • does not show 3D arrangement / does not identify ions/does not show vibration Advantages and disadvantages of C • shows relative sizes / 3D nature / two different ions/particles • does not show ions/charges/bonding/vibration **AO1.1 Knowledge and understanding of the ideal diagram** • needs to show ions/charges/bonds • shows (two different) types of particle • needs to show sizes • needs to show 3D nature (and identify elements) • needs to show vibration **IGNORE** references to electrons / electron configuration For full marks terms need to be correct e.g. ‘vibration’ (not ‘movement’) and ‘ions’ (not molecules/atoms/protons/electrons)

Question			Answer	Marks	AO element	Guidance
	8*		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)** Describes experimental procedures and gives expected observations **AND** states the order of reactivity *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)** Describes an experimental procedure and gives the expected observation **OR** Describes one experimental procedure and states the order of reactivity *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)** Makes a statement to describe an experimental procedure **OR** States the order of reactivity *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.	**6**	**4 x 1.1** **1 x 3.3a** **1 x 3.2b**	**AO3.3a Analyse information and ideas to develop experimental procedures** • add each halogen to all three halides • (OR) add each halogen to halides of less reactive elements / chlorine to bromide and bromine to iodide **AO1.1 Knowledge and understanding of scientific techniques and procedures to give expected observations** • temperature increases when chlorine is added to potassium bromide/iodide / when bromine is added to potassium iodide • chlorine when added to potassium iodide gives brown colour • chlorine when added to potassium bromide gives brown colour • bromine when added to potassium iodide gives brown colour • any other combinations do not give a colour change/no (displacement) reaction/stays colourless / no temperature change **ALLOW** yellow or red or orange for bromine **ALLOW** yellow or orange or grey <u>solid</u> for iodine **AO3.2b Order of reactivity** • order of reactivity is chlorine – bromine – iodine • reactivity decreases down the group **IGNORE** any mention of astatine **ALLOW** 1 mark for general statement linking reactivity to displacement

Question			Answer	Marks	AO element	Guidance
9	**(a)**		The melting point of chromium ~ the melting point of vanadium. ✓ The melting point of copper >> the melting point of mercury ✓	**2**	**2.1**	
	(b)		Mercury has a MP below room temperature / has a negative MP / is a liquid (at room temperature and pressure) ✓ Zinc only forms one (positive) ion / transition metals form ions with different charges ✓ The oxide of zinc is white / oxides of transition metals are usually coloured ✓	**3**	**1.1**	**IGNORE** low melting point **IGNORE** mercury has ions with the same charge
	(c)		CuO ✓ Cu_2O ✓	**2**	**1.1** **2.1**	**IGNORE** superscripted charges on ions
	(d)		contain oxygen ✓ has a negative charge ✓	**2**	**1.2**	
	(e)		Transition metals make good catalysts. ✓	**1**	**1.1**	

Question			Answer	Marks	AO element	Guidance
10	(a)	(i)	**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 1.8 x 10^{-4} / 0.00018 (%) award 2 marks** 1800 x 1.0 x 10^{-7} / 1800 x 10^{-7} ✓ = 1.8 x 10^{-4} / 0.00018 ✓	**2**	**2x2.2**	**ALLOW** 1 mark for 1.8 x 10^{-10}
		(ii)	concentration/amount of methane or nitrous oxides is (much) lower than carbon dioxide / concentration of carbon dioxide is the highest ✓ is over 200 times higher / comments that nitrous oxides are also measured in ppb / nitrous oxides have similar concentration to methane / nitrous oxide concentration is 1.4 x 10^{-4} / 0.00014 ✓	**2**	**2x3.2a**	Answer must be comparative **IGNORE** 'low' alone
	(b)		**Amaya**: (no) Different units / ppm (CO_2) and ppb (NO) ✓ **James:** (not 3 times higher) because idea that vertical axis does not start at 0 / gives values for carbon dioxide as 270-280 and more than 350 ppm / 3 times is 750-850 ppm / only increases by 1.4-1.6 ✓ **Layla**: (not 50% increase) started at 600-700 ✓ now more than 1900 ppb / 50% increase would give 900-1100 / increase is (about 3 times/200%) greater ✓ **Amir:** (yes or no) (for all three gases) overall pattern/trend is the same / all three gases increase in a similar trend / all stay the same then increase ✓ small up and down variations (do not follow same pattern) ✓	**6**	**3.1a** **3.1a** **2 x2.2** **2x3.1b**	**IGNORE** clear trend alone **IGNORE** they show a (positive) correlation (in the question) **IGNORE** differences <u>between</u> the gases

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