

Higher

GCSE

Combined Science B Twenty First Century Science

J260/06: Chemistry (Higher Tier)

General Certificate of Secondary Education

Mark Scheme for June 2024

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It is also responsible for developing new specifications to meet national requirements and the needs of students and teachers. OCR is a not-for-profit organisation; any surplus made is invested back into the establishment to help towards the development of qualifications and support, which keep pace with the changing needs of today's society.

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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MARKING INSTRUCTIONS

PREPARATION FOR MARKING

RM ASSESSOR

1. Make sure that you have accessed and completed the relevant training packages for on-screen marking: *RM Assessor Online Training*; *OCR Essential Guide to Marking*.
2. Make sure that you have read and understood the mark scheme and the question paper for this unit. These are available in RM Assessor.
3. Log-in to RM Assessor and mark the **required number** of practice responses ("scripts") and the **required number** of standardisation responses.

MARKING

1. Mark strictly to the mark scheme.
2. Marks awarded must relate directly to the marking criteria.
3. The schedule of dates is very important. It is essential that you meet the RM Assessor 50% and 100% (traditional 50% Batch 1 and 100% Batch 2) deadlines. If you experience problems, you must contact your Team Leader (Supervisor) without delay.
4. If you are in any doubt about applying the mark scheme, consult your Team Leader by telephone, email or via the RM Assessor messaging system.

5. Work crossed out:
- where a candidate crosses out an answer and provides an alternative response, the crossed out response is not marked and gains no marks
 - if a candidate crosses out an answer to a whole question and makes no second attempt, and if the inclusion of the answer does not cause a rubric infringement, the assessor should attempt to mark the crossed out answer and award marks appropriately.
6. Always check the pages (and additional objects if present) at the end of the response in case any answers have been continued there. If the candidate has continued an answer there then add a tick to confirm that the work has been seen.
7. There is a NR (No Response) option. Award NR (No Response)
- if there is nothing written at all in the answer space
 - OR if there is a comment which does not in any way relate to the question (e.g. 'can't do', 'don't know')
 - OR if there is a mark (e.g. a dash, a question mark) which isn't an attempt at the question.
- Note: Award 0 marks – for an attempt that earns no credit (including copying out the question).
8. The RM Assessor **comments box** is used by your Team Leader to explain the marking of the practice responses. Please refer to these comments when checking your practice responses. **Do not use the comments box for any other reason.**
- If you have any questions or comments for your Team Leader, use the phone, the RM Assessor messaging system, or email.
9. Assistant Examiners will send a brief report on the performance of candidates to their Team Leader (Supervisor) via email by the end of the marking period. The report should contain notes on particular strengths displayed as well as common errors or weaknesses. Constructive criticism of the question paper/mark scheme is also appreciated.

10. For answers marked by levels of response:

Read through the whole answer from start to finish, using the Level descriptors to help you decide whether it is a strong or weak answer. The indicative scientific content in the Guidance column indicates the expected parameters for candidates' answers, but be prepared to recognise and credit unexpected approaches where they show relevance. Using a 'best-fit' approach based on the skills and science content evidenced within the answer, first decide which set of level descriptors, Level 1, Level 2 or Level 3, best describes the overall quality of the answer.

Once the level is located, award the higher or lower mark:

The higher mark should be awarded where the level descriptor has been evidenced and all aspects of the communication statement (in *italics*) have been met.

The lower mark should be awarded where the level descriptor has been evidenced but aspects of the communication statement (in *italics*) are missing.

In summary:

The skills and science content determines the level.

The communication statement determines the mark within a level.

Level of response question on this paper **6a**

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11. 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

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12. 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

13. 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 B:

	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)	(i)	Carbon (atom) / 1.54×10^{-10} AND silver (atom) / 2.88×10^{-10} ✓	1	2.2	
		(ii)	Carbon (atom) / 1.54×10^{-10} Silver (atom) / 2.88×10^{-10} Fullerene (molecule) / 1.10×10^{-9} Platinum (nanoparticle) / 1.00×10^{-8} ✓✓	2	2.2	ALLOW 1 mark if carbon is put as smallest OR 1 mark for platinum nanoparticle being biggest
	(b)		As size/particle gets bigger, (surface area to volume) ratio gets smaller. ORA ✓ OR Size increase ten times, (surface area to volume) ratio decreases ten times/size and ratio are inversely proportional ORA ✓✓	2	3.1a	ALLOW size increases 10 times ratio decreases to/by a tenth/words to the effect of going up and down by factor of 10
	(c)		First check the answer on answer line If answer = 600 (nm²) award 3 marks Length of one face = 10nm ✓ Substitution: surface area = $6 \times (10 \times 10)$ ✓ = 600 (nm ²) ✓	3	2.2	ALLOW mark if 10 is seen in marking ALLOW ECF from incorrect length/breadth DO NOT ALLOW $6 \times 6 \times 6$ unless qualified/ DO NOT ALLOW h and w not the same ALLOW ECF from incorrect substitution If candidate has measured the sides of the cube shown by labels on the diagram: MP1 does not score MP2 ECF for their values (need not be the same)

Question			Answer	Marks	AO element	Guidance
						MP3 ECF from substitution

Question			Answer	Marks	AO element	Guidance
2	(a)		Any two from: Volume of acid/50cm ³ of acid – measuring cylinder/burette/pipette/graduated beaker ✓ Temperatures measured at start – thermometer ✓ Temperatures measured after each addition/at end– thermometer ✓ Mass/1g of solid/calcium hydroxide portions – balance ✓	2	3.3a	IGNORE amount of acid/solid ALLOW temperature (change).- using thermometer for 1 mark ALLOW scales for balance IGNORE weight/weighing IGNORE measurement of time ALLOW 1 mark for 2 measurements or 2 pieces of apparatus measuring different things.
	(b)		All points correctly plotted ✓✓	2	2.2	Any two points correctly plotted = 1 mark ALLOW +/- Half square tolerance
	(c)		Line of best fit ✓	1	2.2	Line must start at 0/22 and end at 5/59.5 and be straight line. ALLOW ECF from incorrectly plotted points IGNORE line outside grid
	(d)		$Y=mx+c$ ✓	1	3.1a	
	(e)		First check the answer on answer line If answer = 28.5 (°C) award 2 marks Selection of data from graph: 50.5°C ✓ (Change in temperature: 50.5 – 22.0) = 28.5 °C ✓	2	3.1a	ALLOW 50-51 °C ALLOW 28-29 °C
	(f)		First check the answer on answer line If answer = 6104.7 (J) award 3 marks Mass of hydrochloric acid: 50 x 1.02 = 51(g) ✓ Substitution: change in thermal energy = 4.2 x 28.5 x 51 ✓	3	2.2	ALLOW minimum of 2 significant figures ALLOW 3 marks if answer is correct for answer to part e. ALLOW ECF from answer to (e)/ incorrectly evaluated mass of acid

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Question			Answer	Marks	AO element	Guidance
			= 6104.7(J) ✓			ALLOW correct evaluation from mp2 IGNORE incorrect rounding on answer line if correct evaluation given in working.

Question			Answer	Marks	AO element	Guidance																								
3	(a)		<table><tr><th>Particle</th><th>Relative mass</th><th>Relative charge</th></tr><tr><td>Proton</td><td>1</td><td>+1</td></tr><tr><td>Neutron</td><td>1</td><td>0</td></tr><tr><td>Electron</td><td>Negligible / 1/1800/ 1/2000</td><td>-1</td></tr></table> ✓✓✓	Particle	Relative mass	Relative charge	Proton	1	+1	Neutron	1	0	Electron	Negligible / 1/1800/ 1/2000	-1	3	1.1	6 correct = 3 marks 5 or 4 correct = 2 marks 3 or 2 correct = 1 mark ALLOW <table><tr><th>Particle</th><th>Relative mass</th><th>Relative charge</th></tr><tr><td>Proton</td><td>+1</td><td>Plus one/one positive/1+</td></tr><tr><td>Neutron</td><td>+1</td><td>Neutral</td></tr><tr><td>Electron</td><td>0 / very small/tiny/ 0.0005/</td><td>Minus one/one negative/1-</td></tr></table>	Particle	Relative mass	Relative charge	Proton	+1	Plus one/one positive/1+	Neutron	+1	Neutral	Electron	0 / very small/tiny/ 0.0005/	Minus one/one negative/1-
Particle	Relative mass	Relative charge																												
Proton	1	+1																												
Neutron	1	0																												
Electron	Negligible / 1/1800/ 1/2000	-1																												
Particle	Relative mass	Relative charge																												
Proton	+1	Plus one/one positive/1+																												
Neutron	+1	Neutral																												
Electron	0 / very small/tiny/ 0.0005/	Minus one/one negative/1-																												
	(b)		First check the answer on answer line If answer = 6700 (m) award 2 marks Conversion: (6.7÷100 =) 0.067 ✓ 0.067 x (1 x 10 ⁵) = 6.7 x 10 ³ / 6700 (m) ✓	2	1.2 2.2	ALLOW ECF in MP2 for incorrect conversion/ ALLOW 6.7 x 10 ⁵ / 670000 for 1 mark																								
	(c)		<table><tr><td></td><td>P</td><td>Na⁺</td></tr><tr><td>Number of protons</td><td>15</td><td>11</td></tr><tr><td>Number of neutrons</td><td>16</td><td>12</td></tr><tr><td>Number of electrons</td><td>15</td><td>10</td></tr></table> Electrons ✓ Neutrons ✓ Protons ✓		P	Na⁺	Number of protons	15	11	Number of neutrons	16	12	Number of electrons	15	10	3	2.2													
	P	Na⁺																												
Number of protons	15	11																												
Number of neutrons	16	12																												
Number of electrons	15	10																												
	(d)		Magnesium small number electrons in outer shell AND fluorine large number ✓ Metals/magnesium lose electrons(to give full outer shell) AND Non-metals/fluorine gains ✓	2	1.1	IGNORE magnesium has 2 electrons in outer shell AND fluorine has 7 electrons in outer shell unless reason why 2 electrons are lost/1 electron gained is given/linked to small/large elsewhere.																								

Question			Answer	Marks	AO element	Guidance
4	(a)		Good electrical conductors – electrons can move (between the ions) ✓ Malleable – Ions can slide over each other ✓ High melting point – strong attraction/force between ions and electrons ✓	3	1.1	ALLOW delocalised. IGNORE free/carry the charge. ALLOW atoms/layers ALLOW bonds between ions and electrons. DO NOT ALLOW atoms, molecules, ionic bonds etc
	(b)		Magnesium loses electrons/is oxidised. ✓ More easily (than copper). ✓	2	2.1	ALLOW Magnesium gives electrons to copper ions. IGNORE magnesium displaces copper
	(c)	(i)	$\text{Cu} + 2\text{Ag}^+ \rightarrow \text{Cu}^{2+} + 2\text{Ag}$ Correct species ✓ Balancing ✓	2	2.2	DO NOT ALLOW balancing of incorrect species.
		(ii)	Magnesium/Mg Iron /Fe Copper / Cu Silver /Ag ✓✓	2	3.2b	Mg most reactive and silver least reactive = 1 mark Iron more reactive than copper = 1 mark

Question			Answer	Marks	AO element	Guidance												
5	(a)		Any two from: Assume (inelastic) spheres/not actual shape ✓ Don't show true scale/actual size (of particles)/actual space between particles ✓ Don't show interactions/attractions/bonds between particles/atoms/molecules ✓ Don't show movement/collisions of particles ✓ Don't show electron etc ✓	2	1.1													
	(b)		<table><tr><td></td><td>Movement of particles</td><td>Arrangement of particles</td></tr><tr><td>Solid</td><td>Vibration (about a fixed point) ✓</td><td></td></tr><tr><td>Liquid</td><td>Moving/sliding past each other ✓</td><td>Close together ✓</td></tr><tr><td>Gas</td><td></td><td>Random ✓ Far apart ✓</td></tr></table>		Movement of particles	Arrangement of particles	Solid	Vibration (about a fixed point) ✓		Liquid	Moving/sliding past each other ✓	Close together ✓	Gas		Random ✓ Far apart ✓	4	1.1	5 correct = 4 marks 4 correct = 3 marks 2 or 3 correct = 2 marks 1 correct = 1 mark DO NOT ALLOW Fairly/quite close together ALLOW irregular
	Movement of particles	Arrangement of particles																
Solid	Vibration (about a fixed point) ✓																	
Liquid	Moving/sliding past each other ✓	Close together ✓																
Gas		Random ✓ Far apart ✓																
	(c)		Particles gain (kinetic) energy ✓ (and) move faster/move apart/move more ✓ OR Energy breaks/weakens force between particles ✓ Particles move further apart/move more ✓	2	1.1	ALLOW atoms/molecules/ions for particles DO NOT ALLOW idea of moving apart if clearly referring to solid to liquid change 1 mark if both points made but no reference to particles etc ALLOW heat for energy. IGNORE temperature/heating/heated												
	(d)		Gas ✓	1	3.2a													

Question			Answer	Marks	AO element	Guidance
6	(a)*		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) Detailed description of titration method AND explanation of how this gives quality data. <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) Detailed description of titration method. OR Some details of titration method AND some explanation of how this gives quality data. <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) Basic description of titration method. <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	1.2	AO1.2 Demonstrates knowledge and understanding of the procedure for a titration to give high quality data (accuracy, precision, repeatability, reproducibility) • measure the sodium hydroxide/acid • into container • add indicator • Add acid/sodium hydroxide bit by bit • Until colour change • Note volume of acid • Use of conical flask/pipette/burette • put on white tile • note initial/ volume on burette • swirl flask when adding the acid/sodium hydroxide • note volume on when colour changes • do a rough one first • repeat until results close together • add acid drop by drop near end point • rinse pipette/burette with solution Quality data explanation: • pipette gives exact volume each time • burette small graduations/controllable tap • white tile helps to see colour change • swirling so acid all mixed in • rough one helps to know roughly where end point is • drop by drop so don't go past end point • repeated results test consistency / precision

Question			Answer	Marks	AO element	Guidance
	(b)	(i)	To get a rough idea of when colour change happens/to see when need to add slowly ✓	1	1.2	ALLOW Student has added too much acid/has gone past colour change/air bubble in burette
		(ii)	First check the answer on answer line If answer = 25.3 (cm³) award 3 marks (25.4 + 25.3 + 25.2 + 25.2 =) 101.1 ✓ (101.1 ÷ 4 =) 25.275 ✓ = 25.3 (cm ³) (1dp) ✓	3	2.2 x 2 1.2	ALLOW 2 marks if answer on answer line is 25.7(cm ³) (25.4 + 25.3 + 25.2 + 25.2 + 27.2 =) 128.3 (128.3 ÷ 5 =) 25.66 = 25.7 (cm ³) (1dp)
		(iii)	Accuracy – not good/good because experimental result (25.3cm ³) is not/is close to true value (25.8cm ³) ✓ Precision – good because (all but rough/titration 1) close together ✓	2	3.1b	ALLOW ECF from bii ALLOW Accuracy –good because experimental result (25.7cm ³) is close to true value (25.8cm ³) / is not good because they are not the same✓ ALLOW Precision – if all 5 readings considered then not good because readings not all close together ✓

Question			Answer	Marks	AO element	Guidance
7	(a)	(i)	Reversible ✓	1	1.1	ALLOW reaction goes both ways IGNORE equilibrium
		(ii)	Ammonia reacts back to hydrogen and nitrogen / products react to form reactants ✓	1	1.1	ALLOW go back to/turn back into
	(b)	(i)	(Increase in temperature) decreases the yield. ✓ (Increase in pressure) increases the yield. ✓ Catalyst yield – no effect ✓ Catalyst rate – increase ✓	4	3.1a x 2 1.1 x 2	
		(ii)	Temperature: Particles have more KE/move faster. ✓ More (chance of) effective collisions/more (chance of) successful collisions/more particles have enough energy to react/more particles have activation energy. ✓ Pressure Particle move closer together. ✓ More frequent collisions. ✓	4	1.1	IGNORE more/more chance of collisions unqualified by reference to successful/effective e.g. more frequent alone DO NOT ALLOW either mark if refers to move more vigorously/faster/have more energy. ALLOW correct references to numbers of particles in volume/area/less space ALLOW increased chance of collisions/particles collide more often IGNORE more collisions unqualified by idea of time.
	(c)		$2 \text{ NH}_3(\text{g}) + \text{H}_2\text{SO}_4(\text{aq}) \rightarrow (\text{NH}_4)_2\text{SO}_4(\text{aq})$ Balancing ✓ State symbols ✓	2	2.2 1.2	Balancing and state symbols dependent on correct formulae.

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Question			Answer	Marks	AO element	Guidance
8	(a)	(i)	(sulfuric acid + copper oxide) Copper sulfate ✓ (calcium carbonate, calcium nitrate) Nitric acid ✓	2	2.1	
		(ii)	Water ✓	1	1.2	ALLOW hydrogen oxide IGNORE H ₂ O
	(b)	(i)	Increase in H ⁺ concentration gives decrease in pH ORA ✓ (Increase in H ⁺ concentration) by 10 (gives decrease in pH) by 1 ✓	2	2.2	IGNORE references to more or less acidic.
		(ii)	4 ✓	1	2.2	
	(c)	(i)	Compare colour of Universal indicator with colour chart /pH chart ✓	1	1.2	IGNORE comparisons of colour with acid/alkaline /neutral ALLOW comparisons of colour with pH e.g red is pH 1/green is pH7
		(ii)	Use a pH meter ✓	1	1.2	IGNORE pH machine

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	(b)	(i)	Solution shown in a container in contact with electrodes/ label showing electrolyte/sodium sulfate solution in container ✓ Test tubes over electrodes/label indicating where test tubes should be ✓ Solution in test tubes shown by a surface in the tube /label ✓	3	1.2	MAX 2 marks for drawing with no labels/labels with no drawing ALLOW 'bung' labelled as electrolyte/sodium sulfate solution / ions drawn. ALLOW a gas syringe/tube attached to whole container (i.e. has not collected gases separately)/suitable label indicating a gas syringe or tube DO NOT ALLOW sealed top to container in the given diagram
		(ii)	Water/H ₂ O ✓	1	1.2	
		(iii)	Sodium more reactive (than hydrogen) / sodium higher in reactivity series (than hydrogen)/hydrogen ions gain electrons more readily (than sodium ions) ORA ✓	1	2.2	ALLOW 'it' with no names instead of hydrogen
		(iv)	Anode – oxygen AND cathode – hydrogen ✓ $2\text{H}^+ + 2\text{e}^- \rightarrow \text{H}_2$ ✓ $4\text{OH}^- \rightarrow \text{O}_2 + 2\text{H}_2\text{O} + 4\text{e}^-$ ✓	3	2.2	ALLOW marking points 2 and 3 if shown at incorrect electrode

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