

Higher

GCSE

Chemistry B Twenty First Century Science

J258/03: Breadth in Chemistry (Higher Tier)

General Certificate of Secondary Education

Mark Scheme for June 2022

OCR (Oxford Cambridge and RSA) is a leading UK awarding body, providing a wide range of qualifications to meet the needs of candidates of all ages and abilities. OCR qualifications include AS/A Levels, Diplomas, GCSEs, Cambridge Nationals, Cambridge Technicals, Functional Skills, Key Skills, Entry Level qualifications, NVQs and vocational qualifications in areas such as IT, business, languages, teaching/training, administration and secretarial skills.

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. Crossed Out Responses

Where a candidate has crossed out a response and provided a clear alternative then the crossed out response is not marked. Where no alternative response has been provided, examiners may give candidates the benefit of the doubt and mark the crossed out response where legible.

Rubric Error Responses – Optional Questions

Where candidates have a choice of question across a whole paper or a whole section and have provided more answers than required, then all responses are marked and the highest mark allowable within the rubric is given. Enter a mark for each question answered into RM assessor, which will select the highest mark from those awarded. *(The underlying assumption is that the candidate has penalised themselves by attempting more questions than necessary in the time allowed.)*

Multiple Choice Question Responses

When a multiple choice question has only a single, correct response and a candidate provides two responses (even if one of these responses is correct), then no mark should be awarded (as it is not possible to determine which was the first response selected by the candidate).

When a question requires candidates to select more than one option/multiple options, then local marking arrangements need to ensure consistency of approach.

Contradictory Responses

When a candidate provides contradictory responses, then no mark should be awarded, even if one of the answers is correct.

Short Answer Questions (requiring only a list by way of a response, usually worth only **one mark per response**)

Where candidates are required to provide a set number of short answer responses then only the set number of responses should be marked. The response space should be marked from left to right on each line and then line by line until the required number of responses have been considered. The remaining responses should not then be marked. Examiners will have to apply judgement as to whether a 'second response' on a line is a development of the 'first response', rather than a separate, discrete response. *(The underlying assumption is that the candidate is attempting to hedge their bets and therefore getting undue benefit rather than engaging with the question and giving the most relevant/correct responses.)*

Short Answer Questions (requiring a more developed response, worth **two or more marks**)

If the candidates are required to provide a description of, say, three items or factors and four items or factors are provided, then mark on similar basis – that is downwards (as it is unlikely in this situation that a candidate will provide more than one response in each section of the response space.)

Longer Answer Questions (requiring a developed response)

Where candidates have provided two (or more) responses to a medium or high tariff question which only required a single (developed) response and not crossed out the first response, then only the first response should be marked. Examiners will need to apply professional judgement as to whether the second (or a subsequent) response is a 'new start' or simply a poorly expressed continuation of the first response.

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. Award No Response (NR) if:

- there is nothing written in the answer space.

Award Zero '0' if:

- anything is written in the answer space and is not worthy of credit (this includes text and symbols).















Team Leaders must confirm the correct use of the NR button with their markers before live marking commences and should check this when reviewing scripts.

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. 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

11. 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

12. 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.

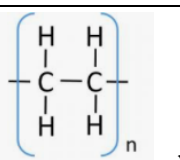
You should ensure also that you are familiar with the administrative procedures related to the marking process. These are set out in the OCR booklet **Instructions for Examiners**. If you are examining for the first time, please read carefully **Appendix 5 Introduction to Script Marking: Notes for New Examiners**.

Please ask for help or guidance whenever you need it. Your first point of contact is your Team Leader.

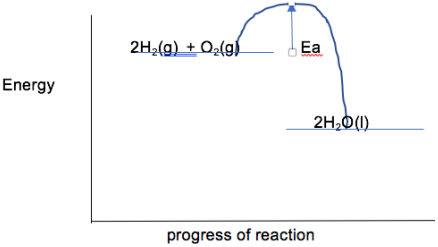
The breakdown of Assessment Objectives for GCSE (9-1) in Chemistry B:

	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)	H ₂ ✓ (g) ✓	2	2.1	DO NOT ALLOW h ₂
	(b) (i)	FIRST CHECK THE ANSWER ON ANSWER LINE If answer = 0.4 (cm³/s), award three marks. Volume after 1 minute = 24 (cm ³) ✓ 1 minute = 60 s ✓ Rate = vol÷time / 24÷60 = 0.4 (cm ³ /s) ✓	3	2.2 1.2 2.2	ALLOW 25 (cm ³) ALLOW ECF on incorrect volume for MP2 and MP3 ALLOW 0.416666.../0.42 (from reading of 25) ALLOW MP3 for volume÷time if time is left in minutes IGNORE incorrect rounding (assessed elsewhere)
	(ii)	The gas/hydrogen given off has mass/weight / gas/hydrogen escapes from the flask ✓	1	3.2b	ALLOW 'it makes a gas' 'hydrogen is made' alone
	(c)	reaction is faster / rate increases ✓ (define catalyst) catalysts are unchanged at the end / are not used up ✓ (evidence) the colour change (from blue to colourless) <u>shows that</u> copper sulfate is not a catalyst/shows that copper sulfate is used up ✓	3	3.1b	IGNORE 'more gas is produced in the first minute' IGNORE 'catalysts speed up reactions' alone ALLOW 'it' for copper sulfate throughout. IGNORE 'blue colour changes to colourless' alone (both in the question)
	(d)	The particles are moving faster ✓ There are more frequent collisions ✓	2	1.1	

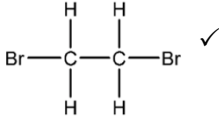
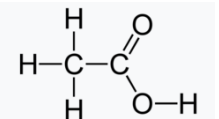
Question		Answer	Marks	AO element	Guidance													
2	(a)	poor ✓ hard ✓	2	1.1	ALLOW does not conduct													
	(b)	<table border="0" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 20%;"></td> <td style="text-align: center;">Material</td> <td style="text-align: center;">Property</td> </tr> <tr> <td style="border: 1px solid black; padding: 5px; text-align: center;">Aluminium</td> <td rowspan="2" style="border: none; padding: 0 10px;">}</td> <td style="border: 1px solid black; padding: 5px;">Softens easily when heated.</td> </tr> <tr> <td style="border: none;"></td> <td style="border: 1px solid black; padding: 5px;">Goes out of shape if dropped.</td> </tr> <tr> <td style="border: 1px solid black; padding: 5px; text-align: center;">Poly(ethene)</td> <td rowspan="2" style="border: none; padding: 0 10px;">}</td> <td style="border: 1px solid black; padding: 5px;">Breaks if dropped.</td> </tr> <tr> <td style="border: none;"></td> <td style="border: 1px solid black; padding: 5px;">Rusts quickly.</td> </tr> </table> <p>✓✓✓</p>		Material	Property	Aluminium	}	Softens easily when heated.		Goes out of shape if dropped.	Poly(ethene)	}	Breaks if dropped.		Rusts quickly.	3	2.1	One mark for correct choice for each material If two lines from a material, that material is incorrect.
	Material	Property																
Aluminium	}	Softens easily when heated.																
		Goes out of shape if dropped.																
Poly(ethene)	}	Breaks if dropped.																
		Rusts quickly.																
	(c)	 <p>✓</p>	1	2.2	ALLOW answer without brackets or n Bonds at each side must be shown													
	(d)	nucleotides ✓	1	1.1														

Question		Answer	Marks	AO element	Guidance
3	(a)	Liquids are difficult to squash because the particles are tightly packed. ✓	1	1.1	1 st box
	(b)	In real life, the molecules of water and carbon dioxide attract each other ✓	1	1.1	2 nd box
	(c)	photosynthesis ✓ carbon dioxide absorbed/decreased / oxygen evolved/increased ✓	2	1.1	
	(d)	(Ling is wrong:) CO ₂ levels are increasing (now/recently) ✓ (Ali is correct) causes climate change/global warming/(enhanced) greenhouse effect ✓	2	3.1b	ALLOW CO ₂ was lower (approx.) 280 MYA ALLOW idea of CO ₂ being released now from human activity ALLOW specific outcomes of climate change e.g ice caps/flooding/extinction/direct impact on ecosystems ALLOW 'affects' climate change

Question		Answer	Marks	AO element	Guidance
4	(a)	Exothermic ✓	1	1.1	
	(b)	 <p>Labelling of lines $2\text{H}_2 + \text{O}_2$ and $2\text{H}_2\text{O}$ ✓</p> <p>single upward arrow as shown labelled E_a ✓</p>	2	1.1	<p>ALLOW hydrogen and oxygen and water ALLOW missing state symbols</p> <p>ALLOW double headed arrow or line with 'marks' at each end / <u>solid</u> line DO NOT ALLOW downward arrow / dotted lines / dotted arrows Arrow must start and end at correct level (by eye) ALLOW any unambiguous labelling for 'E_a'</p>
	(c)	The energy needed for a reaction to occur ✓	1	1.1	
	(d)	<p>FIRST CHECK THE ANSWER ON ANSWER LINE If answer for energy given out = 486 (kJ/mol) award 3 marks</p> <p>Broken = $(2 \times 436) + 498 = 1370$ ✓</p> <p>Made = $4 \times 464 = 1856$ ✓</p> <p>Given out = $1370 - 1856 = (-) 486$ (kJ/mol) ✓</p>	3	2.2	<p>ALLOW 1370/1856 on either line ALLOW correct number string for M1 or M2 if answer is not calculated</p> <p>ALLOW ECF for M3 IGNORE sign + or -</p>

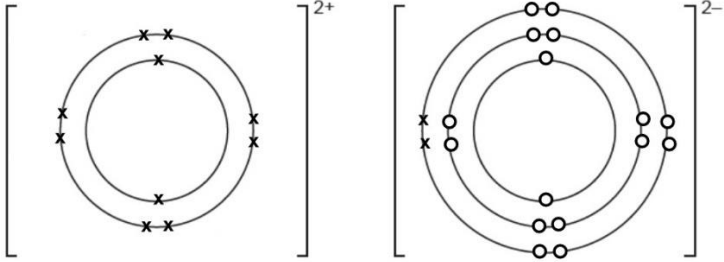
Question		Answer	Marks	AO element	Guidance
5	(a)	It does not conduct electricity ✓	1	1.1	
	(b)	<p>FIRST CHECK THE ANSWER ON ANSWER LINE If answer = 51.5 (cm³) award 3 marks</p> <p>RFM = $2 \times 126.9 = 253.8$ ✓</p> <p>Volume = $253.8 \div 4.93$ (ratios) OR Number of moles = $4.93 \div 253.8$ <u>followed by</u> $1 \div \text{ans}$ ✓</p> <p>Volume = 51.5 (cm³) to 1 dp ✓</p>	3	2.2 x 2 1.2	<p>ALLOW 127 as Ar of Iodine used throughout</p> <p>ALLOW ECF from incorrect RFM ALLOW 2 marks for 25.7 (used 126.9 as RFM) / 25.8 (used 127 as RFM) ALLOW any answer <u>with working</u> to 1dp for MP3</p>
	(c) (i)	brown colour (of iodine)✓	1	1.1	<p>ALLOW red-brown / orange-brown / yellow-brown / yellow IGNORE black/grey (solid) DO NOT ALLOW any other colour mentioned</p>
	(ii)	iodine less reactive than chlorine (ORA) ✓	1	1.1	<p>ALLOW reactivity decreases down the group / more reactive halogens displace less reactive halogens ALLOW AW for 'further down the group' e.g. halogen with the higher atomic number</p>
	(d)	74 ✓ 53 ✓	2	1.2	

	(e)	<p>FIRST CHECK THE ANSWER ON ANSWER LINE If formula = PI_3 award 3 marks</p> <p>Number of moles of P = $7.5 \div 31 = 0.24$ ✓</p> <p>Number of moles of I = $92.5 \div 126.9 = 0.73$ ✓</p> <p>ratio = 1:3 so formula = PI_3 ✓</p>	3	2.2	<p>ALLOW (1) if no other marks awarded for showing 31 and 126.9/127/254/253.8 in working</p> <p>ALLOW 127 as Ar of Iodine used throughout</p> <p>ALLOW $0.075 \div 31 = 0.0024$</p> <p>ALLOW $0.925 \div 126.9/127 = 0.0073$</p>
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Question		Answer	Marks	AO element	Guidance
6	(a)	To make useful short chain molecules ✓	1	1.1	4 th box
	(b)		1	2.1	ALLOW any displayed formula for CH ₂ BrCH ₂ Br
	(c) (i)	Ring around C=C ✓ Ring around O-H ✓	2	1.2	DO NOT ALLOW other atoms within the ring.
	(ii)	ethanoic acid ✓	1	1.2	
	(iii)		1	1.2	ALLOW -OH
	(d)	The intermolecular forces in ethanol are stronger than those in ethene ✓	1	1.1	

Question			Answer	Marks	AO element	Guidance
7	(a)	(i)	$\text{Fe}^{3+} + 3\text{e}^- \rightarrow \text{Fe}$ ✓	1	1.2	
		(ii)	gains electrons ✓	1	1.1	IGNORE any numbers given
	(b)		<p>FIRST CHECK THE ANSWER ON ANSWER LINE If answer = 69.9 (%), award 3 marks.</p> <p>$M_r(\text{Fe}_2\text{O}_3) = 55.8 \times 2 + 16.0 \times 3 = 159.6$ ✓</p> <p>$\% = 55.8 \times 2$ or $111.6 \div 159.6 \times 100 = 69.92\dots/0.6992\dots$ (any sf) ✓</p> <p>$\% = 69.9$ (3sf) ✓</p>	3	<p>2.2 x 2</p> <p>1.2</p>	<p>ALLOW (2) for 70.0 / 70 % with no working</p> <p>ALLOW 56 used as A_r of Fe, leading to 70.0 / 70 % <u>for a maximum of 2 marks</u></p> <p>ALLOW any answer <u>with working</u> to 3 sig figs for MP3</p>
	(c)		<p>Paint OR grease/oil OR cover with another metal/galvanise ✓ Stops water AND oxygen/air reaching iron ✓</p> <p>OR</p> <p>Add a sacrificial metal/galvanise ✓ More reactive metal corrodes/reacts instead of the steel ✓</p> <p>OR</p> <p>Alloy with another metal / make it into stainless steel ✓ Alloys have a greater resistance to corrosion ✓</p>	2	2.2	<p>IGNORE 'coating' alone</p> <p>IGNORE more reactive metal 'rusts'</p> <p>IGNORE 'mix with another metal'</p>

	(d)	<p>Advantages – Any one from: uses less energy (than making iron and steel from iron ore) ✓ Conserves raw materials / less need to extract new metals ✓ Reduces landfill / reduces waste ✓</p> <p>Disadvantages – Any one from: There is plenty of iron ore left ✓ Uses energy <u>for</u> collecting/sorting/transporting scrap steel (for recycling) ✓ Separating recycled metals is difficult ✓</p>	2	3.2a	<p>IGNORE 'saves steel / uses less steel / less new steel is made' ALLOW iron is finite</p> <p>IGNORE requires energy to dispose of used steel/requires energy for recycling</p> <p>IGNORE uses energy for any process at the steelworks e.g. shaping etc. IGNORE recycled steel is poorer quality/weaker</p>
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Question		Answer	Marks	AO element	Guidance
8	(a)	Mg / magnesium is above/higher in reactivity series / more reactive <u>than iron/Fe</u> ✓	1	2.2	DO NOT ALLOW just magnesium is more reactive 'It' = magnesium
	(b)	Electrostatic attraction / forces between positive and negative ions ✓ strong attraction between ions / strong (ionic) bonds / lots of energy required to break the (ionic) bond / lots of energy to overcome the attraction (between ions) ✓	2	1.1	DO NOT ALLOW strong attraction/bonds/forces between <u>molecules</u> / strong covalent bonds
	(c)	 <p style="text-align: center;">Mg²⁺ ✓ S²⁻ ✓</p>	2	1.2	Mg²⁺ : All electrons for Mg must be the same (dots or crosses) DO NOT ALLOW a mixture of dots and crosses for Mg S²⁻ : Allow two different electrons in the outer shell or all electrons the same ALLOW all electrons the same on both diagrams

Question		Answer	Marks	AO element	Guidance
9	(a)	carbon dioxide ✓	1	1.1	ALLOW CO ₂
	(b)	(i) (experiment 2 is faster because) powder has larger surface area (ora) ✓ Higher frequency of (successful) collisions between particles / higher rate of collisions / more collisions per unit time (ora) ✓	2	1.2	DO NOT ALLOW reaction is slower for MP1 IGNORE 'more collisions' alone IGNORE 'more successful collisions' alone
		(ii) FIRST CHECK THE ANSWER ON ANSWER LINE If answer = 2.5 award 2 marks Ratio is 10:4 or 10/4 ✓ Rate = 2.5 ✓	2	2.2	ALLOW correct answer written in the table ALLOW 2.5 in working for (1) if further working leads to incorrect answer
	(c)	Experiment 3: number greater than 10 ✓ Experiment 4: number smaller than 10 ✓	2	3.2a	

Question		Answer	Marks	AO element	Guidance
10	(a)	Read from the <u>bottom of</u> the meniscus/curve / take readings at eye level / look perpendicular / ensure burette is level ✓	1	1.2	
	(b)	(Nina's results) results all agree to $\pm 0.1/\pm 0.05$ / all results are similar / concordant / repeating gives similar results ✓ (Another person idea) the same person obtained the results / not checked by another person idea / nobody else has done it ✓	2	3.1a	IGNORE confusion between which term is which ALLOW 'if Nina repeated the titration, results would be similar' IGNORE ideas about '(small) differences i.e. Allow 'the results are different but they are still close together/similar'
	(c)	FIRST CHECK THE ANSWER ON ANSWER LINE If answer = 0.084 (mol / dm³) award 3 marks M1 Mol HCl (= mol NaOH) = $0.20 \times 10.5 / 2.1$ ✓ M2 Conc NaOH = $0.20 \times 10.5 \div 25 / 2.1 \div 25$ ✓ M3 Conc NaOH = 0.084 (mol / dm ³) ✓	3	2.2	ALLOW working for volumes converted into dm ³ ($\div 1000$) (they cancel out) ALLOW ECF on <u>number of moles $\div 25(x10^{-3})$</u> for (1) mark only for MP2 ALLOW ECF for MP3: ALLOW $0.2 \div 25 = 8(x10^{-3})$ (2 marks) ALLOW $10.5 \div 25 = 0.42$ (2 marks)

	(d)	<p>Any two from:</p> <p>Use more concentrated drainclear / do not dilute the drainclear / dilute the drainclear less ✓</p> <p>Use a larger volume of drainclear ✓</p> <p>Use less concentrated acid (less concentrated than 0.2 mol/dm³) ✓</p> <p><u>Given reason results in</u> more acid needed/used <u>up</u> (for neutralisation) / more acid reacts with the drainclear ✓</p>	2	3.3b	<p>ALLOW 'sodium hydroxide' for 'drainclear' throughout</p> <p>ALLOW 'use more drainclear'. IGNORE 'use more dilute drainclear / use more diluted drainclear'</p> <p>IGNORE 'use more acid'. Answer must imply or state that more acid is needed/reacts/used up Last marking point is dependent</p>
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Question			Answer	Marks	AO element	Guidance
11	(a)	(i)	Negative / cathode ✓	1	1.1	
		(ii)	aluminium is a positive ion/cation / has a positive charge / opposite charges attract / needs to gain electrons ✓	1	1.1	ALLOW aluminium ion is Al ³⁺ IGNORE aluminium (ion) is reduced
	(b)	(i)	hydrogen is below sodium in the reactivity series / hydrogen is less reactive than sodium (ora) ✓	1	1.1	IGNORE sodium is very/too reactive
		(ii)	2H ⁺ + 2e → H ₂ H ⁺ and electron(s) ✓ completely correct ✓	2	2.2	ALLOW halved/multiples ALLOW max (1) if h used for H Number of electrons does not need to be correct for MP1
	(c)		Cell or powerpack shown to provide current ✓ two measuring cylinders (placed over electrodes) ✓	2	1.2 3.3a	ALLOW answers on the diagram IGNORE gas syringes ALLOW test-tubes shown with graduations / burettes

Question		Answer	Marks	AO element	Guidance
12	(a)	<p>Any two from:</p> <p>it is pure because it is a single substance / it is a compound ✓</p> <p>it is (ionically) bonded/combined ✓</p> <p>cannot be separated easily/by physical means ✓</p>	2	1.1	<p>ALLOW it has a sharp/definite melting/boiling point</p> <p>IGNORE 'covalent' or 'molecule' Look for idea of compound for MP1 and bonded for MP2. The type of bonding is tested elsewhere on the paper.</p>
	(b) (i)	copper sulfate + sodium hydroxide → copper hydroxide + sodium sulfate ✓	1	2.2	
	(ii)	$\text{Ba}^{2+} + \text{SO}_4^{2-} \checkmark \rightarrow \text{BaSO}_4 \checkmark$	2	2.2	<p>ALLOW (1) mark for BaSO_4 <u>as a product</u> / $\text{Ba}^{2+} + \text{SO}_4^{2-}$ <u>as reactants</u>;</p> <p>ALLOW $\text{Ba}^{2+}\text{SO}_4^{2-}$</p> <p>DO NOT ALLOW $\text{Ba}^{2+}\text{SO}_4 / \text{BaSO}_4^{2-}$</p> <p>(2) marks for fully correct equation</p>

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