OCR
RECOGNISING ACHIEVEMENT

SPECIMEN **H**

GENERAL CERTIFICATE OF SECONDARY EDUCATION

TWENTY FIRST CENTURY SCIENCE

CHEMISTRY A **A172/02**

Unit A172: Modules C4, C5, C6 (Higher Tier)

MARK SCHEME

MAXIMUM MARK 60

This document consists of 16 pages

Guidance for Examiners

Additional guidance within any mark scheme takes precedence over the following guidance.

1. Mark strictly to the mark scheme.
2. Make no deductions for wrong work after an acceptable answer unless the mark scheme says otherwise.
3. Accept any clear, unambiguous response which is correct, eg mis-spellings if phonetically correct (but check additional guidance).
4. Abbreviations, annotations and conventions used in the detailed mark scheme:

   / = alternative and acceptable answers for the same marking point
   (1) = separates marking points
   not/reject = answers which are not worthy of credit
   ignore = statements which are irrelevant - applies to neutral answers
   allow/accept = answers that can be accepted
   (words) = words which are not essential to gain credit
   <u>words</u> = underlined words must be present in answer to score a mark
   ecf = error carried forward
   AW/owtte = alternative wording
   ORA = or reverse argument

   Eg mark scheme shows 'work done in lifting / (change in) gravitational potential energy' (1)
   work done = 0 marks
   work done lifting = 1 mark
   change in potential energy = 0 marks
   gravitational potential energy = 1 mark

5. Annotations:
   The following annotations are available on SCORIS.

   ✓ = correct response
   ✖ = incorrect response
   bod = benefit of the doubt
   nbod = benefit of the doubt **<u>not</u>** given
   ECF = error carried forward
   ^ = information omitted
   I = ignore
   R = reject

6. If a candidate alters his/her response, examiners should accept the alteration.

7. Crossed out answers should be considered only if no other response has been made. When marking crossed out responses, accept correct answers which are clear and unambiguous.

   Eg
   For a one mark question, where ticks in boxes 3 and 4 are required for the mark:

Put ticks (✓) in the two correct boxes.	Put ticks (✓) in the two correct boxes.	Put ticks (✓) in the two correct boxes.
☐	☐	✓
☐	☐	✓
✓	✓	☐
✓	✓	☐
☐	☐	☐
This would be worth 0 marks.	This would be worth one mark.	This would be worth one mark.

8. The list principle:
   If a list of responses greater than the number requested is given, work through the list from the beginning. Award one mark for each correct response, ignore any neutral response, and deduct one mark for any incorrect response, eg one which has an error of science. If the number of incorrect responses is equal to or greater than the number of correct responses, no marks are awarded. A neutral response is correct but irrelevant to the question.

9. Marking method for tick boxes:

   Always check the additional guidance.

   If there is a set of boxes, some of which should be ticked and others left empty, then judge the entire set of boxes.
   If there is at least one tick, ignore crosses. If there are no ticks, accept clear, unambiguous indications, eg shading or crosses.
   Credit should be given for each box correctly ticked. If more boxes are ticked than there are correct answers, then deduct one mark for each additional tick. Candidates cannot score less than zero marks.

   Eg If a question requires candidates to identify a city in England, then in the boxes

Edinburgh	
Manchester	
Paris	
Southampton	

   the second and fourth boxes should have ticks (or other clear indication of choice) and the first and third <u>should be blank</u> (or have indication of choice crossed out).

Edinburgh			✓			✓	✓	✓	✓	
Manchester	✓	×	✓	✓	✓				✓	
Paris				✓	✓		✓	✓	✓	
Southampton	✓	×		✓		✓	✓		✓	
Score:	2	2	1	1	1	1	0	0	0	NR

10. Three questions in this paper are marked using a Level of Response (LoR) mark scheme with embedded assessment of the Quality of Written Communication (QWC). When marking with a Level of Response mark scheme:

- Read the question in the question paper, and then the list of relevant points in the 'Additional guidance' column of the mark scheme, to familiarise yourself with the expected science. The relevant points are not to be taken as marking points, but as a summary of the relevant science from the specification.
- Read the level descriptors in the 'Expected answers' column of the mark scheme, starting with Level 3 and working down, to familiarise yourself with the expected levels of response.
- *For a general correlation between quality of science and QWC*: determine the level based upon which level descriptor best describes the answer; you may award either the higher or lower mark within the level depending on the quality of the science and/or the QWC.
- *For high-level science but very poor QWC*: the candidate will be limited to Level 2 by the bad QWC no matter how good the science is; if the QWC is so bad that it prevents communication of the science the candidate cannot score above Level 1.
- *For very poor or totally irrelevant science but perfect QWC*: credit cannot be awarded for QWC alone, no matter how perfect it is; if the science is very poor the candidate will be limited to Level 1; if there is insufficient or no relevant science the answer will be Level 0.

Question			Expected answers	Mark	Additional guidance
1			*metals:* the conclusion is supported but the melting point of Al is only slightly higher than Mg *non-metals:* the conclusion is supported for S, Cl and Ar but P is lower than S / P does not follow the trend could collect data for other periods to help evaluate the conclusions	[3]	**allow** S not following trend
			Total	[3]	

Question			Expected answers	Mark	Additional guidance
2			the similarity is that they will both have lines the difference is that the lines will be different colours / the lines will be in different places / the lines will be in a different pattern	[2]	
			Total	[2]	

Question			Expected answers	Mark	Additional guidance
3	(a)		**[Level 3]** Most of the properties are discussed with clear comparison made. Discusses nuclear content, electron configuration and ions using actual numbers of particles /shells. All information in the answer is relevant, clear, organised and presented in a structured and coherent format. Specialist terms are used appropriately. Few, if any, errors in grammar, punctuation and spelling. (5-6 marks) **[Level 2]** Compares structure of nucleus, electronic structure and ions. For the most part the information is relevant and presented in a structured and coherent format. Specialist terms are used for the most part appropriately. There are occasional errors in grammar, punctuation and spelling. (3-4 marks) **[Level 1]** Some structure described but clear comparison may not be made. Discusses structure of nucleus and / or electronic configuration. Answer may be simplistic. There may be limited use of specialist terms. Errors of grammar, punctuation and spelling prevent communication of the science. (1-2 marks) **[Level 0]** Insufficient or irrelevant science. Answer not worthy of credit. (0 marks)	[6]	**relevant points include:** • sodium has one electron in the outer shell, fluorine has 7 • sodium has 3 electron shells, fluorine has 2 • sodium has 11 protons, fluorine has 9 • sodium has 12 neutrons, fluorine has 10 • when sodium forms an ion it loses an electron • when fluorine forms an ion it gains an electron • both ions have a stable electron arrangement / full outer shell for Level 2, **accept** 'different numbers of protons / neutrons / electron shells'
			Total	**[6]**	

Question			Expected answers	Mark	Additional guidance
4	(a)		<u>orange gas</u> at start and <u>white solid</u> at end reaction takes 8-12 s / slower than iodine but faster than chlorine	[2]	
	(b)		sodium iodide Na**I**	[1]	both required for the mark, in either order
			Total	[3]	

Question			Expected answers			Mark	Additional guidance
5	(a)			**true**	**false**	[2]	all 4 correct = 2 2 or 3 correct = 1 1 or 0 correct = 0 **accept** other indications of choice (eg lines or crosses)
			… reacts with cold water.	✓			
			… to form compounds.		✓		
			… more quickly than potassium.		✓		
			… is very unstable.				
	(b)		Li and O_2 as reactants correct balancing			[2]	the completed equation will be: $4Li + O_2 \rightarrow 2Li_2O$
			Total			[4]	

<table>
<tr><th colspan="3">Question</th><th>Expected answers</th><th>Mark</th><th>Additional guidance</th></tr>
<tr><td>6</td><td>(a)</td><td></td><td>
<table>
<tr><th></th><th>Andi</th><th>Bea</th><th>Carl</th><th>Di</th><th>none</th></tr>
<tr><td>...reproducibility</td><td>✓</td><td></td><td></td><td></td><td></td></tr>
<tr><td>...hypothesis</td><td></td><td></td><td></td><td>✓</td><td></td></tr>
<tr><td>...outlier</td><td></td><td></td><td></td><td></td><td>✓</td></tr>
<tr><td>...best estimate</td><td></td><td>✓</td><td></td><td></td><td></td></tr>
</table>
</td><td>[2]</td><td>all four correct = 2
3 or 2 correct = 1
1 or 0 correct = 0</td></tr>
<tr><td></td><td>(b)</td><td></td><td>C E B</td><td>[1]</td><td></td></tr>
<tr><td></td><td></td><td></td><td>Total</td><td>[3]</td><td></td></tr>
</table>

Question			Expected answers	Marks	Additional guidance
7			water, H_20 carbon dioxide, $C0_2$	[2]	**credit** 1 mark for any two names/formulae correct
			Total	[2]	

Question			Expected answers	Mark	Additional guidance
8			**[Level 3]** Chooses aluminium and uses its properties to explain suitability. Uses properties of other metals to explain their lack of suitability. Refers to compromise of properties for purpose. All information in the answer is relevant, clear, organised and presented in a structured and coherent format. Specialist terms are used appropriately. Few, if any, errors in grammar, punctuation and spelling. (5-6 marks) **[Level 2]** Chooses aluminium and uses its properties to explain suitability. Makes some reference to properties of other metals but does not explain their lack of suitability. For the most part the information is relevant and presented in a structured and coherent format. Specialist terms are used for the most part appropriately. There are occasional errors in grammar, punctuation and spelling. (3-4 marks) **[Level 1]** Chooses a metal other than aluminium. Makes some relevant comments about its suitability. Answer may be simplistic. There may be limited use of specialist terms. Errors of grammar, punctuation and spelling prevent communication of the science. (1-2 marks) **[Level 0]** Insufficient or irrelevant science. Answer not worthy of credit. (0 marks)	**[6]**	**relevant points include:** • aluminium has lowest density so cable can span long distances • aluminium has good resistance to corrosion so cables will last a long time • aluminium has reasonable conductivity but this is a compromise • aluminium is quite cheap so lots of cables can be used for reasonable cost • gold has very good conductivity but is too heavy and is too expensive • iron is cheap but is too heavy and corrodes too easily • copper has good conductivity but is too heavy and too expensive
			Total	**[6]**	

Question			Expected answers	Mark	Additional guidance
9	(a)	(i)	the (trend shown in the) graph suggests that use of/demand for copper will continue to increase however, large amounts of ore need to be mined to recover a small percentage of copper so we may not be able to mine enough ore to meet the demand / only a small proportion of the copper in the Earth's crust is close enough to the surface to be mined economically	[2]	for full marks the explanation must be expressed in a logical coherent order
		(ii)	used copper could be recycled	[1]	
	(b)	(i)	$\frac{63.5 + 63.5}{63.5 + 63.5 + 16} \times 40$ = 35.5	[2]	
		(ii)	heated reduced oxygen oxidised oxygen	[1]	all correct for the mark **reject** "reacted" / "mixed" / "treated" etc.
			Total	[6]	

Question			Expected answers	Mark	Additional guidance
10	(a)		lead and bromine form lead at the negative electrode and bromine at the positive electrode	[2]	
	(b)		e^- and Na	[1]	both required for the mark
			Total	[3]	

Question			Expected answers	Mark	Additional guidance
11			Electrons are shared between atoms. ✓ The nucleus of each bonded atom ... ✓	[2]	
			Total	[2]	

Question			Expected answers	Marks	Additional guidance
12	(a)		**citric acid**	[1]	
	(b)		the acid and alkali need to dissolve in water to produce H^+ (aq) and OH^- (aq) ions (which are free to react)	[1]	
			Total	[2]	

Question			Expected answers	Marks	Additional guidance
13			she should add acid in small amounts near the end point so that she does not add more acid than necessary to neutralise the alkali **OR** she should swirl the flask between each addition of acid so that the acid mixes completely before adding any more **OR** she should look carefully for first (permanent) colour change so that she does not add more acid than necessary to neutralise the alkali	[2]	**ignore** "do it (more) carefully" for full marks the action Mary takes should be coherently linked to the resulting improvement in accuracy
			Total	[2]	

Question			Expected answers	Marks	Additional guidance
14	(a)		gram formula mass of $MgSO_4$ = 24 + 32 + 64 = 120 g gram formula mass of Mg = 24 g $\frac{3}{24}$ x 120 = 15	[2]	
	(b)		20 ÷ 10 = 2 cm^3/s	[1]	correct working, answer and units required for the mark
	(c)		experiment **A** because a larger mass of magnesium pieces will give a higher rate of reaction, so more gas will have been produced by 10s and a larger mass of reactant will produce a greater volume of product/gas/hydrogen	[3]	for full marks the explanation must be expressed in a logical and coherent order

Question			Expected guidance	Gd	Additional guidance
14	(d)	✎	**[Level 3]** Answer demonstrates an understanding of the nature of the particles involved and the effect of their collisions on the rate of reaction. All information in the answer is relevant, clear, organised and presented in a structured and coherent format. Specialist terms are used appropriately. Few, if any, errors in grammar, punctuation and spelling. (5-6 marks) **[Level 2]** Answer deals with one aspect, eg collision frequency, but does not discuss the nature of the colliding species. For the most part the information is relevant and presented in a structured and coherent format. Specialist terms are used for the most part appropriately. There are occasional errors in grammar, punctuation and spelling. (3-4 marks) **[Level 1]** Answer shows an awareness of the basic premise, that of collisions, but has difficulty identifying the reacting species and sees the reaction in terms of number of collisions rather than frequency. Detail of what constitutes a low-level answer. Answer may be simplistic. There may be limited use of specialist terms. Errors of grammar, punctuation and spelling prevent communication of the science. (1-2 marks) **[Level 0]** Insufficient or irrelevant science. Answer not worthy of credit. (0 marks)	[6]	**relevant points include:** • hydrogen/H^+ ions from the acid • react with magnesium atoms • at the surface of the magnesium • using smaller pieces of magnesium gives a larger surface area • allowing the hydrogen/H^+ ions to collide more frequently with the magnesium atoms • which will increase the rate of reaction **reject** references to increased speed of movement **reject** references to increased concentration of the acid
			Total	**[12]**	

Question			Expected answers	Marks	Additional guidance
15	(a)		HC*l* in reactant box H_2O and CO_2 in product boxes, in either order equation correctly balanced	[3]	the completed equation will be: $CuCO_3 + 2HCl \rightarrow CuCl_2 + H_2O + CO_2$
	(b)		exothermic	[1]	
			Total	[4]	