

Chemistry A

General Certificate of Secondary Education

Unit **A172/02**: Modules C4, C5, C6 (Higher Tier)

Mark Scheme for January 2013

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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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1. Annotations

Used in the detailed Mark Scheme:

Annotation	Meaning
/	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	credit alternative wording / or words to that effect
ORA	or reverse argument

Available in scoris to annotate scripts:

	indicate uncertainty or ambiguity
	benefit of doubt
	contradiction
	incorrect response
	error carried forward
	draw attention to particular part of candidate's response
	no benefit of doubt
	reject
	correct response

<input type="checkbox"/> L1 , <input type="checkbox"/> L2 , <input type="checkbox"/> L3	indicate level awarded for a question marked by level of response
<input type="checkbox"/> ^	information omitted

2. Subject-specific Marking Instructions

- a. Accept any clear, unambiguous response (including mis-spellings of scientific terms if they are *phonetically* correct, but always check the guidance column for exclusions).
- b. 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.
e.g. for a one-mark question where ticks in the third and fourth boxes are required for the mark:

<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

This would be worth 1 mark.

This would be worth 0 marks.

This would be worth 1 mark.

- c. 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, e.g. 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.
- d. Marking method for tick-box questions:

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 and other markings. If there are no ticks, accept clear, unambiguous indications, e.g. shading or crosses. Credit should be given according to the instructions given in the guidance column for the question. 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.

e.g. *if a question requires candidates to identify cities in England:*

Edinburgh	
Manchester	
Paris	
Southampton	

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

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

- e. For answers marked by levels of response:
- i. **Read through the whole answer from start to finish**
 - ii. **Decide the level that best fits the answer** – match the quality of the answer to the closest level descriptor
 - iii. **To determine the mark within the level**, consider the following:

Descriptor	Award mark
A good match to the level descriptor	The higher mark in the level
Just matches the level descriptor	The lower mark in the level

- iv. Use the **L1, L2, L3** annotations in Scoris to show your decision; do not use ticks.

Quality of Written Communication skills assessed in 6-mark extended writing questions include:

- appropriate use of correct scientific terms
- spelling, punctuation and grammar
- developing a structured, persuasive argument
- selecting and using evidence to support an argument
- considering different sides of a debate in a balanced way
- logical sequencing.

Question	Answer	Marks	Guidance
1 (a)	(boiling point for) bromine / -59; (1) bromine is a liquid / must have a boiling point above 20°C / above room temperature / should be higher than chlorine / boiling point should increase (down the group) / boiling point should be higher than the melting point (1)	2	ignore 'it is too low' alone ignore 'it does not fit the pattern' If chlorine is given as answer.... For (1) mark max accept 'chlorine (or -35) because boiling points should increase (down the group)' / 'chlorine boiling point should be lower than bromine (or below -59)' /AW ignore 'chlorine boiling point should be lower' alone, needs a comparison
(b)	Must give bromine as answer in (a) (+59 / accept answers between 20 and 150°C	1	Must be a numerical value accept a numerical range if both values fall between 20 and 150°C
(c)	At ₂	1	do not accept at ₂ or AT ₂ . do not accept At2. 2 must be smaller than letters or subscripted.
	Total	4	

Question	Answer	Marks	Guidance
2	<p>(a)</p> <p>Level 3 (5–6 marks) Discusses properties of group 1 and links why <u>some properties</u> mean that hydrogen fits and <u>some properties</u> mean that it does not fit. Quality of written communication does not impede communication of the science at this level.</p> <p>Level 2 (3–4 marks) Discusses properties of group 1 and links why a property of hydrogen fits and why a property does not fit. Quality of written communication partially impedes communication of the science at this level.</p> <p>Level 1 (1–2 marks) Links some properties of hydrogen for why hydrogen fits OR does not fit group 1. Quality of written communication impedes communication of the science at this level.</p> <p>Level 0 (0 marks) Insufficient or irrelevant science. Answer not worthy of credit.</p>	6	<p>This question is targeted at grades up to A/A*</p> <p>Relevant points include: Fay: Hydrogen fits Group 1 because... <ul style="list-style-type: none"> it has same number/one electron in its outer shell forms an ion with a <u>single</u> positive charge / 1+ charge forms a chloride with a similar formula to Group 1 chlorides (LiCl etc) very flammable / very reactive reacts with non-metals / group 7 elements/halogens Guy: Hydrogen does not fit/should be alone because... <ul style="list-style-type: none"> it is a gas non-metal does not react with water forms compounds with metals (as well as non-metals). (alone because) maximum electrons in outer shell is 2 may gain an electron (to form an ion / give a full shell) forms covalent bonds Properties about Group 1 <ul style="list-style-type: none"> contains solids contains metals elements are flammable / reactive has 1 electron in the outer shell idea that outer shell of common Group 1 elements holds up to 8 electrons form ions with single positive charge very reactive with water only form compounds with non metals react with group 7 elements/halogens do not react with other metals. </p> <p>Use the L1, L2, L3 annotations in Scoris; do not use ticks.</p>

Question	Answer	Marks	Guidance
2 (b) (i)	$2\text{Li(l)} + \text{H}_2\text{(g)} \rightarrow 2\text{LiH(s)}$ (l) (g) and (s) correct (1) 2 and 2 correct (1)	2	do not accept clear capital letters i.e. L and G
(ii)	H^-	1	
(iii)	calcium hydride	1	Must be spelled correctly
	Total	10	

Question	Answer	Marks	Guidance
3 (a)	<p>Any 3 from: idea that if colour is missing then that element is not present / not red then doesn't contain calcium / not yellow doesn't contain sodium; if the flame is blue it might contain arsenic; copper (also) gives blue colour; other elements have similar colours / difficult to tell colours apart idea;</p>	3	
(b)	<p>(If mineral contains arsenic) lines are in the same place/line up/same pattern / each element has its own (unique) spectrum (1) extra lines mean other elements in the mineral (1)</p>	2	<p>accept 'lines match' allow 'others show different lines' for 'extra lines'</p>
(c)	<p>Both atoms have similar relative atomic masses. Arsenic-75 has two more neutrons than arsenic-73. Both atoms have the same number of protons. The number of electron shells is the same.</p>	1	
	Total	6	

Question	Answer	Marks	Guidance
4	<p>Level 3 (5–6 marks) Links a <u>similar</u> and a <u>different</u> property to both structures. Quality of written communication does not impede communication of the science at this level.</p> <p>Level 2 (3–4 marks) Links a property to the structure for diamond <u>or</u> graphite. Quality of written communication partially impedes communication of the science at this level.</p> <p>Level 1 (1–2 marks) <u>Compares properties</u> and/or makes points about structures. Quality of written communication impedes communication of the science at this level.</p> <p>Level 0 (0 marks) Insufficient or irrelevant science. Answer not worthy of credit.</p>	6	<p>This question is targeted at grades up to C</p> <p>Relevant points include:</p> <p>Properties (look for comparison)</p> <ul style="list-style-type: none"> • both have high/similar melting points • both have high/similar boiling points • both are insoluble in water • graphite conducts but diamond does not • diamond is harder (than graphite) (needs comparison) • Graphite flakes/marks paper' and diamond does not (needs comparison) • Appearance of diamond and graphite is different <p>Structures</p> <ul style="list-style-type: none"> • Both have strong bonds • Both have covalent bonds • Both have giant structure / lattice structure / lots of bonds / macromolecule • Both contain carbon atoms • graphite has layers • diamond has four bonds / tetrahedral • graphite has three bonds • graphite has delocalised electrons (accept 'free' electrons) • graphite has weak bonds/ intermolecular forces <u>between layers</u> • graphite has rings / hexagonal structure <p>Similar properties linked to structure</p> <ul style="list-style-type: none"> • (both) high melting / boiling point because strong bonds / giant structure • (both) insoluble because covalently bonded <p>Different properties linked to structure</p> <ul style="list-style-type: none"> • (diamond) hard because strong bonds/ each atom bonded to 4 others <u>and</u> (graphite) Soft/flakes because of layers / weak bonds <u>between layers</u> • (diamond) does not conduct because electrons cannot move and (graphite) conducts because electrons move/are 'free'/delocalised <p>Use the L1, L2, L3 annotations in Scorris; do not use ticks.</p>
	Total	6	

Question	Answer	Marks	Guidance
5 (a) (i)	$63.5 \times 2 / 127; (1)$ $\div 159 \times 100 = 79.9\% / 79.87\% (1)$ any answer correctly rounded to 3 sig figs (1)	3	accept any number of sig figs for (2) (79.87421 etc) (allow ECF on incorrect mass of copper from step 1) '39.9' = (2) scores 2 nd and 3 rd marking points
(ii)	0.799 kg (1)	1	allow ECF allow any sig figs correctly rounded allow 799 g
(b)	<i>any two from:</i> (per tonne of copper produced) less ore needs to be transported / fewer journeys / less traffic ; <u>leading to</u> lower amount of fuel needed / lower amount of energy needed; less CO ₂ produced / less named pollutant e.g. carbon monoxide/particulates/NOx/SOx / less <u>air</u> pollution / less dust / less noise ;	2	ignore pollution / damages environment / damages habitats etc. Must be linked to transport not metal extraction for marking points 2 and 3
	Total	6	

Question	Answer	Marks	Guidance
6 (a)	hydrogen (1) carbon dioxide (1) helium (1)	3	accept correct formula H ₂ CO ₂ and He Formula must be unambiguous and fully correct with subscripts used correctly.
(b)	They do not conduct electricity They all have boiling points above room temperature They form crystals at room temperature They have low melting points They are hard and strong	2	
(c)	The nuclei of the two atoms are attracted together. Electrons are attracted together to form a bond. The nuclei of the two atoms repel each other. The nucleus of each atom attracts the shared electrons The electrons repel the nuclei away from each other	2	
	Total	7	

Question	Answer	Marks	Guidance
7 (a)	<p>CaCO₃ (1)</p> <p>Calcium chloride (1)</p> <p>Correct formula <u>and</u> names: Carbon dioxide + water CO₂ + H₂O (1)</p>	3	<p>If extra numbers are added to incorrectly balance the equation, maximum of 2 marks can be awarded.</p> <p>Formula must be unambiguous and fully correct with subscripts used correctly. Do not allow CO² etc. O in CO₂ must be at least half the size of C i.e. not Co₂</p>

Question	Answer	Marks	Guidance
7	<p>Level 3 (5–6 marks) Describes how to process results to compare rates. Quality of written communication does not impede communication of the science at this level.</p> <p>Level 2 (3–4 marks) Builds on the basic method and gives more details to compare rate of reaction. Quality of written communication partially impedes communication of the science at this level.</p> <p>Level 1 (1–2 marks) Gives a basic method to compare rate of reaction with different acids. Quality of written communication impedes communication of the science at this level.</p> <p>Level 0 (0 marks) Insufficient or irrelevant science. Answer not worthy of credit.</p>	6	<p>This question is targeted up to grade B</p> <p>Relevant points include: Basic method...</p> <ul style="list-style-type: none"> Do experiments with <u>different acids</u> / implies need to compare results of more than one experiment Measure volume or amount of gas / when syringe is full / when reaction ends / measures time for reaction to happen <p>More details...</p> <ul style="list-style-type: none"> same volume / amount of acid same mass / amount of calcium carbonate same size pieces / temperature measurement of <u>time and volume</u> start timing when acid is added repeating and taking an average/mean/look for similar results <p>Process results...</p> <ul style="list-style-type: none"> compare times to produce fixed volume of gas <u>leading to either shorter time faster reaction</u> <u>OR</u> shorter time for more concentrated acid measure volume at regular intervals / measure volume at fixed time <u>leading to either greater volume faster reaction</u> <u>OR</u> greater volume more concentrated acid draw graph of results volume against time <u>leading to either steeper gradient faster reaction</u> <u>OR</u> steeper gradient more concentrated acid <p>accept 'to fill the syringe' as a volume measurement for the basic method but not at level 3 accept amount for mass or volume</p> <p>Use the L1, L2, L3 annotations in Scoris; do not use ticks.</p>

7	(c)	<p>More concentrated acids have larger acid particles</p> <p>At higher concentrations there are more particles in the same volume</p> <p>Collision rate increases when particles are closer together</p> <p>Higher concentrations of acid split the calcium carbonate to give a bigger surface area</p> <p>Reactions are faster when particles have less energy</p>	<table border="1"> <tr><td></td></tr> <tr><td>✓</td></tr> <tr><td>✓</td></tr> <tr><td></td></tr> <tr><td></td></tr> </table>		✓	✓			2	
✓										
✓										
		Total	11							
8	(a)	<p>The first result is usually lower than the others.</p> <p>The first titration is done without an indicator.</p> <p>The students do not follow the method carefully the first time.</p> <p>The first result is used to give a rough idea of the volume needed.</p>	<table border="1"> <tr><td></td></tr> <tr><td></td></tr> <tr><td></td></tr> <tr><td>✓</td></tr> </table>				✓	1		
✓										
	(b)	<p>Any 3 from (Dee's result) is too low / lower than the others;</p> <p>Amy (going past the end point would make) volume of sodium hydroxide higher / volume would be 'too high';</p> <p>Ben (If the vinegar was more concentrated) more sodium</p>		3	<p>no marks for 'Carl' alone all marks are for explanations Maximum 2 marks can be scored if Carl is not given as answer ignore 'Dee's result is very different / it is an outlier'</p>					

	hydroxide would be needed/ volume would be 'too high' / all from the same bottle/ same vinegar/ same concentration; Carl Must have measured out <u>too little</u> vinegar at the start / AW;		ignore 'made mistakes when she measured the volume'
(c)	$H^+ + OH^- \rightarrow H_2O$ (1)	2	ignore state symbols
	Total	6	
9	(a) RFM = 98 (1) $(98 / 40) \times 5 = 12.25$ g (1)	2	Check table for RFM allow ecf for wrong formula mass incorrect RFM ÷ 8 scores (1)
(b)	Look for a comparison: 40 g and 120 g / RFM 40 and 120 (1) <u>RFM</u> in 1: 3 ratio idea / <u>40</u> x3 idea (1)	2	accept correctly rounded answers to fewer sig figs i.e. 12 g/12.3 g
	Total	4	ignore '3 x' alone' or '3 x mass of magnesium oxide' alone (in the question) 40 x 3 = 120 scores 2 marks

OCR (Oxford Cambridge and RSA Examinations)
1 Hills Road
Cambridge
CB1 2EU

OCR Customer Contact Centre

Education and Learning

Telephone: 01223 553998

Facsimile: 01223 552627

Email: general.qualifications@ocr.org.uk

www.ocr.org.uk

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Head office
Telephone: 01223 552552
Facsimile: 01223 552553

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