

**GCSE**

**Chemistry A**

Unit **A173/02**: Module C7 (Higher Tier)

General Certificate of Secondary Education

**Mark Scheme for June 2017**

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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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### Annotations

Used in the detailed Mark Scheme:

Annotation	Meaning
/	alternative and acceptable answers for the same marking point
(1)	separates marking points
<b>not/reject</b>	answers which are not worthy of credit
<b>ignore</b>	statements which are irrelevant - applies to neutral answers
<b>allow/accept</b>	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 RM Assessor 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

L1 , L2 , L3	draw attention to particular part of candidate's response
^	information omitted

### 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:*

<del>✗</del>
<del>✗</del>

*This would be worth  
1 mark.*

✓
<del>✗</del>

*This would be worth  
0 marks.*

<del>✗</del>
<del>✗</del>
✓
✓

*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	<input type="checkbox"/>
Manchester	<input type="checkbox"/>
Paris	<input type="checkbox"/>
Southampton	<input type="checkbox"/>

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		✓		✓	✓		✓	
<b>Score:</b>	<b>2</b>	<b>2</b>	<b>1</b>	<b>1</b>	<b>1</b>	<b>1</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>NR</b>

## 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 RM Assessor 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)	(i)	sodium chloride; (1) HCl and NaCl ; (1)	2	<b>Ignore</b> incorrect balancing The 'l' in HCl and NaCl must be lower case – only penalise if it is an obvious capital
		ii	(reacts with/ neutralises hydrochloric) <u>acid/HCl</u> ; (1) Carbon dioxide/CO <sub>2</sub> quoted as the product; (1)	2	Do not allow second marking point if other products are listed



<p><b>[Level 3]</b> Makes statements about use of equipment including correct use of volumetric flask (to make up standard solution) and ways to ensure accuracy. Quality of written communication does not impede communication of the science at this level. (5 – 6 marks)</p> <p><b>[Level 2]</b> Makes statements about use of equipment and/or accuracy (to make up standard solution).  Quality of written communication partly impedes communication of the science at this level. (3 – 4 marks)</p> <p><b>[Level 1]</b> Makes statements to describe how to make a standard solution. Quality of written communication impedes communication of the science at this level. (1 – 2 marks)</p> <p><b>[Level 0]</b> Insufficient or irrelevant science. Answer not worthy of credit. (0 marks)</p>	6	<p><b>This question is targeted at grades up to A</b></p> <p><b>Indicative scientific points may include:</b></p> <p><b>Accuracy</b></p> <ul style="list-style-type: none"> <li>• Take care not to lose solid or solution in transfer</li> <li>• Wash beaker/rod/funnel to make sure nothing left behind/ all solid enters (the flask)</li> <li>• Use pipette to add exactly enough water</li> <li>• Make sure meniscus is on the line</li> <li>• Water must be distilled to make sure no impurities present</li> </ul> <p><b>Use of equipment</b></p> <ul style="list-style-type: none"> <li>• Weigh solid/ find mass/ use balance to measure solid</li> </ul> <p><b>Beaker + water + solid</b></p> <ul style="list-style-type: none"> <li>• Use glass rod (to stir)</li> <li>• Transfer to volumetric flask</li> <li>• Use funnel (to transfer solution to flask)</li> <li>• Add liquid up to the line</li> </ul> <p><b>Basic</b></p> <ul style="list-style-type: none"> <li>• Add solid to water/water to solid</li> <li>• Dissolve</li> <li>• Stir</li> </ul> <p>Correct use of volumetric flask is a gatekeeper for level 3</p> <p><b>Use the L1, L2, L3 annotations in RM Assessor; do not use ticks.</b></p>	
<b>Question</b>	<b>Answer</b>	<b>Marks</b>	<b>Guidance</b>

Question			Answer	Marks	Guidance
1	(c)	(i)	10.0 (2 marks)  Working to show either 2.5/250 or 250/1000 or 2.5/0.25 or 5.0 x 2 or 2.5 x 4; (1)	2	Allow 10 instead of 10.0
		(ii)	0.25 ( 2 marks)  Working to show 2.5 x 100 or 2.5/10 or 100/1000; (1)	2	
<b>Total</b>				<b>14</b>	
2	(a)	(i)	<i>Any 2 from:</i>  Range is wide/ results vary ;  Identifies range 8 / 19 to 27 ;  19.0/ result 4 is an outlier ;  Rough reading should be above accurate ;	2	<b>Alternatives to first point</b> results not concordant/consistent/repeatable/ values are quite far away from each other / fluctuates too much/ there is a range. <b>Ignore</b> reliable  "Range = 8" is a two mark answer  outlier must be identified
		(ii)	Pipette	1	<b>Allow</b> burette <b>Ignore</b> balance/ syringe/ teat pipette/ volumetric flask
		(b)	(i)	24.0, 23.5, 23.0	1
		(ii)	23.5 (2 marks)  adds values and divides by 3 ;(1)	2	Allow ecf on three ringed values from (b) (i) for (2) marks  If all four values used, allow ecf for 1 mark <b>only</b> if correct working <b>and</b> correct answer (23.875 or 23.9 etc) given If all five values used, = 24.1
		(iii)	Answer to the calculation = 4.7;(1)  What is then <b>done</b> to the answer (yes because) <b>to one significant figure</b> (this is 5) / it <b>rounds up</b> (to 5) ; (1)	2	Allow ecf (b) (ii) ÷ 5, with the yes/no for the second point depending on their result  '5' without working or explanation = 0  If yes/no choice wrong, first mark can still be awarded
<b>Total</b>				<b>8</b>	

Question	Answer	Marks	Guidance
3	<p><b>[Level 3]</b> Makes statements about an energy change for both combustion and making hydrogen and discusses sustainability. Quality of written communication does not impede communication of the science at this level. (5 – 6 marks)</p> <p><b>[Level 2]</b> Makes statements about an energy change for both combustion and making hydrogen OR makes a statement about an energy change and discusses sustainability.  Quality of written communication partly impedes communication of the science at this level. (3 – 4 marks)</p> <p><b>[Level 1]</b> Makes a statement about an energy change. Quality of written communication impedes communication of the science at this level. (1 – 2 marks)</p> <p><b>[Level 0]</b> Insufficient or irrelevant science. Answer not worthy of credit. (0 marks)</p>	6	<p><b>This question is targeted at grades up to A*</b></p> <p><b>Indicative scientific points may include:</b></p> <p><b>Sustainability</b></p> <ul style="list-style-type: none"> <li>energy given out when hydrogen burns is <u>the same as</u> the energy taken in when it forms.</li> <li>fossil fuels are used to supply energy</li> <li>high activation energy for making hydrogen means more fuel needed idea</li> </ul> <p><b>Points about combustion energy change</b></p> <ul style="list-style-type: none"> <li>Combustion reaction is exothermic/ gives out energy</li> <li>(Combustion reaction gives out) a <b>lot</b> of energy</li> <li>Hydrogen combustion has a small activation energy</li> </ul> <p><b>Points about making hydrogen energy change</b></p> <ul style="list-style-type: none"> <li>Making hydrogen is endothermic/ takes in energy</li> <li>(Making hydrogen takes in) a <b>lot</b> of energy</li> <li>large activation energy</li> </ul> <p>If energy change described correctly but <i>named</i> wrongly – count as impeded communication Don't double penalise incorrect sustainability statements</p> <p><b>Ignore</b> comments about pollution</p> <p><b>Accept</b> at Level 1 only 'Hydrogen (only) forms water (during combustion)</p> <p><b>Use the L1, L2, L3 annotations in RM Assessor; do not use ticks.</b></p>

Question		Answer				Marks	Guidance
4	(a)	$9\text{CO}_2 + 10\text{H}_2\text{O}$ correct formulae (1) balancing (1)				2	Either way round  <b>Allow 1 mark</b> for $9\text{CO}_2$ or $10\text{H}_2\text{O}$ if no other mark is scored.
	(b) (i)	<pre>       H   H   H   H                     H - C - C - C - C - H                           H   H   H   H           </pre> ; (1)  butane ; (1)				2	NO ecf on the name  All bonds and hydrogen atoms should be shown
	(ii)	statement	only true for octane	only true for ethene	true for both	3	All rows correct (3) 3 correct (2) 1 or 2 correct (1)  Any row with more than one tick is incorrect
		contain all single bonds	✓				
		molecules are unsaturated		✓			
		molecules are hydrocarbons			✓		
		unreactive with aqueous solutions	✓				
<b>Total</b>					<b>7</b>		

Question		Answer	Marks	Guidance
5	(a)	reversible reaction; (1)  do not reach 100 % <u>yield</u> / to increase the <u>yield</u> ; (1)	2	<b>Ignore</b> references to equilibrium  <b>Ignore</b> statements about efficiency, unreacted ethene
	(b)	Rate argument <b>High(er)</b> temperature increases rate (or vice versa); (1)  idea that this is in opposition to yield / makes a small amount but faster; (1)	2	<b>Caution</b> Stem - Lower temp gives higher yield.  <b>Ignore</b> 'Temperature increases rate' <b>Accept</b> "Too cool" as meaning 'low temperature'  The candidate must contrast the two [opposing] effects of rate and yield – a useful indicator is the use of the word ' <b>but</b> '.  <b>Accept</b> argument from other direction 'lower temp reduces rate, <b>but</b> is balanced by higher yield' = 2
	(c)	High(er) pressure increases/favours yield/rate ORA; (1)  Recognises that the acid is a catalyst OR Catalyst/phosphoric acid increases rate/ lowers activation energy; (1)	2	<b>Ignore</b> just quoting the conditions. Must state both direction of change and effect.  <b>Ignore</b> "pressure" increases yield/rate  <b>Accept</b> 'catalyst increases forward rate' <b>Con</b> 'increases forward rate but not backward rate'  <b>Ignore</b> statements about collisions <b>Ignore</b> additional statements such as " <i>but don't take part in the reaction</i> "

	(d)	<p><b>Statement about ethanol</b> (ethanol because) it becomes a liquid (when cooled/ produced);(1)</p> <p><b>Statement about ethene</b> ethene does not become a liquid / ethene stays a gas</p>	2	<p>Information has to come from the flow chart, so emphasis must be on change or lack of change shown by the flowchart</p> <p>(ethanol because) it liquefies before ethene = 2</p> <p><b>Ignore</b> 'ethene is a gas' [without any justification for this statement]</p> <p><b>Ignore</b> 'because ethene is recycled' [from flowchart, and they are told to use the flowchart, but the answer doesn't take it far enough]</p> <p>If ethene is suggested, CON for one mark</p>
		<b>Total</b>	<b>8</b>	
<b>Question</b>	<b>Answer</b>		<b>Marks</b>	<b>Guidance</b>

<p>6</p> <p><b>[Level 3]</b> Describes the similarity and difference between the two reactions in some detail Quality of written communication does not impede communication of the science at this level. (5 – 6 marks)</p> <p><b>[Level 2]</b> Makes a statement about both a similarity AND a difference OR gives statements about one aspect only.  Quality of written communication partly impedes communication of the science at this level. (3 – 4 marks)</p> <p><b>[Level 1]</b> Makes a statement about a similarity OR a difference.  Quality of written communication impedes communication of the science at this level. (1 – 2 marks)</p> <p><b>[Level 0]</b> Insufficient or irrelevant science. Answer not worthy of credit. (0 marks)</p>		<p>6</p>	<p><b>This question is targeted at grades up to C</b></p> <p><b>Indicative scientific points may include:</b></p> <p><b>Similarities</b></p> <ul style="list-style-type: none"> <li>• both are esterification / both make an ester</li> <li>• both produce <u>small molecules</u></li> <li>• both have an atom economy of less than 100%</li> <li>• both (organic) products contain COO (group)</li> <li>• both (organic) products contain C<sub>2</sub>H<sub>5</sub> (group)</li> <li>• both have a double bond [unspecified] / <b>ignore</b> “and is unsaturated” but QWC incorrect “saturated”</li> </ul> <p><b>Ignore ethanol a reactant in each – STEM</b> <b>Ignore</b> each reactant contains a hydrocarbon [but accept hydrocarbon chain] <b>Ignore</b> incorrect names for organic compounds (but see below)</p> <p><b>Differences</b></p> <ul style="list-style-type: none"> <li>• different reagent, reagent in 2 is not a (carboxylic acid/ contains Cl/ is an acid with chlorine in it (accept a difference indicated by different but incorrect names)</li> <li>• different (organic) product/ester / different number of carbons (accept cmpd in reaction 2 ‘is larger’) (accept a difference indicated by different but incorrect names)</li> <li>• different by-products made / H<sub>2</sub>O and HCl</li> </ul> <p><b>Accept</b> ‘reaction 2’ or ‘the other product’ or ‘the other reaction’</p> <p><b>Use the L1, L2, L3 annotations in RM Assessor; do not use ticks.</b></p>
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Question		Answer	Marks	Guidance
7	(a)	old process has a waste (product)/ sodium sulfite ; (1)  new process has no waste (product) / all products are useful ; (1)	2	Ignore statements about yield  Ignore 'less waste' Ignore 'all the atoms are used'
	(b)	<i>any 3 from:</i>  higher yield ;  higher atom economy ;  does not have any waste (products) / only by-products / all products useful ;  (waste from older process) toxic/harmful ;  needs less/fewer raw materials/ does not use sulfuric acid/ sodium hydroxide	3	ignore statements about energy
	(c) (i)	<i>any 2 from:</i>  using renewable raw materials / reduce use of fossil fuels; <b>reducing</b> temperature of process ; <b>reducing</b> pressure of process ; using <b>less</b> energy ; reducing health and safety risks ; adding a catalyst	2	Ignore 'increasing yield' (in the question)  Statements about sustainability are another way of making statements about 'green-ness'.  Candidates do not have to put each response onto a separate suggestion line  Ignore wrong answers unless they contradict correct responses.



	(ii)	<p><b>Quality of the Data</b> Repeat/ to make data more reliable/ to get more information/ repeatability/ accuracy/ compare the data</p> <p><b>Use of data/ significance of data</b> Evaluation/ analyse/ disprove theories/ new directions/ share ideas</p>	2	<p>'Peer Review' is a one-mark only answer</p> <p>"to form a consensus" not quite enough – what are they forming a consensus about?</p> <p>Candidates do not have to put each response onto a separate suggestion line</p>
	(d)	<p>Enzymes speed up chemical reactions. <input type="checkbox"/></p> <p>Enzymes have specific pH ranges. <input checked="" type="checkbox"/></p> <p>Enzymes provide alternative routes for reactions. <input type="checkbox"/></p> <p>Enzymes work best at a narrow optimum temperature range. <input checked="" type="checkbox"/></p> <p>Enzymes reduce activation energy. <input type="checkbox"/></p>	2	<p>Both correct (2) 1 correct (1)</p>
		<b>Total</b>	<b>11</b>	

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