

Chemistry A

General Certificate of Secondary Education

Unit **A171/02**: Modules C1, C2, C3 (Higher Tier)

Mark Scheme for June 2012

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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
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
	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:

✗
✗

*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	<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		✓		✓	✓		✓	
Score:	2	2	1	1	1	1	0	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)	<p>(Level 3) Answer gives a detailed explanation of how carbon dioxide level in air decreased then increased and how oxygen level increased. Quality of written communication does not impede communication of the science at this level. (5–6 marks)</p> <p>(Level 2) Answer gives detailed explanation of the changes in carbon dioxide level decrease and oxygen level increase OR a detailed explanation of carbon dioxide increase OR a partial explanation of all changes to carbon dioxide and oxygen. Quality of written communication partly impedes communication of the science at this level. (3–4 marks)</p> <p>(Level 1) Answer attempts to explain one change involving carbon dioxide or oxygen level. Quality of written communication impedes communication of the science at this level. (1–2 marks)</p> <p>(Level 0) Insufficient or irrelevant science. Answer not worthy of credit. (0 marks)</p>	6	<p>This question is targeted at grades up to A</p> <p>Indicative scientific points may include: Decrease in carbon dioxide</p> <ul style="list-style-type: none"> plants developed plants photosynthesised photosynthesis removed carbon dioxide photosynthesis produces O₂ which caused levels in the air to rise carbon dioxide dissolved in oceans and formed sedimentary rocks formation of fossil fuels trapped carbon dioxide carbon dioxide fell to 0.03% <p>Increase in carbon dioxide</p> <ul style="list-style-type: none"> respiration and photosynthesis balanced carbon dioxide in air humans burned fossil fuels fossil fuels produce carbon dioxide when burned carbon dioxide has risen to 0.04% due to human activity <p>Use the L1, L2, L3 annotations in Scoris; do not use ticks.</p>	
	(b)	(i)	calcium sulfate (1)	1	<p>allow calcium sulphate do not allow formula do not allow calcium sulfide / calcium sulfite</p>
		(ii)	alkaline / (an) alkali (1)	1	allow a base
		(iii)	carbon dioxide is a pollutant/harms the environment/causes global warming/causes greenhouse effect (1)	1	no mark for simply saying it gives off carbon dioxide/carbon dioxide level will rise
			Total	9	

Question			Answer	Marks	Guidance
2	(a)	(i)	Cal (1)	1	if more than one answer given = 0
		(ii)	Ed (1)	1	if more than one answer given = 0
	(b)		<p><i>any three from:</i></p> <p><u>pattern</u> (maximum 2 marks) nitrogen dioxide (concentration) is highest when number of cars is highest / more nitrogen dioxide when more cars used (1) nitrogen dioxide is lowest when number of cars is lowest / less nitrogen dioxide when fewer cars used (1) graph has two peaks and there are two times when traffic level is high / peaks on graph coincide with high number of cars (1)</p> <p><u>explanation</u> nitrogen dioxide produced by cars (1) nitrogen and oxygen from air react (in car engines) (1)</p>	3	<p>allow there is a positive correlation between nitrogen dioxide (concentration) and number of cars for <u>both</u> pattern marks (2) (if positive missed out then just one mark)</p> <p>pattern answers must link the graph with the tables</p> <p>explanation must link to pattern</p> <p>be careful not to allow nitrogen rather than nitrogen dioxide</p>
	(c)	(i)	<p><i>any two from:</i></p> <p>how far different it is from the other values (1) how much variation there is in the other values / how big the range is (1) whether the equipment was faulty (1) whether the air conditions may have been different for this value (1)</p>	2	<p>ignore whether it was an outlier/anomaly</p> <p>ignore error unless qualified eg scientists made a mistake</p> <p>allow an explanation eg measuring equipment closer to road / more cars passing when sample 2 was taken (compared to when the other samples were taken)</p> <p>do not allow idea of more cars on the road at this time of day or on this day</p>
		(ii)	more cars on day 2 / fewer cars on day 1 (1)	1	<p>allow other sensible suggestions eg less windy on day 2 / rained on day 1</p> <p>answer must fit with the fact that the nitrogen dioxide concentration on day 2 was higher than that on day 1</p>

Question		Answer	Marks	Guidance
	(d)	<p>Fossil fuels are burned to generate ... <input checked="" type="checkbox"/> (1)</p> <p><input type="checkbox"/></p> <p>As fossil fuels are burned, pollutant ... <input checked="" type="checkbox"/> (1)</p> <p><input type="checkbox"/></p> <p>Electric cars have batteries that ... <input checked="" type="checkbox"/> (1)</p> <p><input type="checkbox"/></p>	3	
		Total	11	

Question		Answer	Marks	Guidance
3	(a)	<p>other factors may change the outcome / so only the type of polymer affects the results (1)</p> <p>the factor under investigation will no longer be the only one that can affect the outcome / it will not be possible to compare results for the different polymers/ropes (1)</p>	2	<p>ignore references to fair test/accurate results</p> <p>allow answers that refer to examples of factors</p>
	(b)	<p><i>any two from:</i></p> <p>no link because D does not fit the pattern / there is a link if D is ignored/is taken as an outlier (1)</p> <p>(in general) as stretchiness decreases, strength increases / there is a negative correlation between stretchiness and strength / ora (1)</p> <p>C/B is stronger than D but stretches more (1)</p>	2	<p>do not credit idea that some did not fit the pattern, must refer specifically to D</p> <p>allow hold more mass before breaking/ they can hold more mass = strength increases (but not just more mass unqualified)</p> <p>do not credit answers that refer to the mass of the rope</p> <p>do not allow answer that says no link but then goes on to describe a link</p>
	(c)	<p>Polymer E has less plasticizer ... <input checked="" type="checkbox"/> (1)</p> <p>Polymer E has cross-linked chains ... <input checked="" type="checkbox"/> (1)</p> <p><input type="checkbox"/></p> <p><input type="checkbox"/></p> <p><input type="checkbox"/></p>	2	

Question		Answer	Marks	Guidance
	(d)	<p>the polymers have different sized forces between their molecules/chains (1)</p> <p>the greater the forces, the more energy is needed/the harder it is to separate the molecules/break the rope (1)</p>	2	<p>the stronger the intermolecular forces the stronger the polymer = 2 marks</p> <p>do not allow 'to break the chain'</p> <p>do not allow 'to break the bonds' unless it is clear that these are bonds between molecules/chains</p> <p>ignore references to chain length/cross linking/plasticizers</p>
	(e)	<p>it stretches but not too much / it is fairly stretchy / average stretchiness / stretchiness is middle of the ropes (1)</p> <p>it is quite strong / takes a lot of load before breaking (1)</p> <p>correct comparison with others eg some others break too easily / some others stretch too much / the strongest/E does not stretch enough / it is a compromise for stretch and strength (1)</p>	3	<p>first two marks are for interpreting data to get properties of C</p> <p>do not allow it is stretchy/strong without qualification</p> <p>third mark is to link this to reason for choice by comparison</p>
Total			11	

Question		Answer	Marks	Guidance															
4	(a)	hydrogen and carbon (1)	1	both required, either order allow H and C															
	(b)	<table border="1"> <thead> <tr> <th></th> <th>true</th> <th>false</th> </tr> </thead> <tbody> <tr> <td>There are hydrocarbon molecules of many different sizes.</td> <td>✓</td> <td></td> </tr> <tr> <td>Most of the hydrocarbon molecules are used for chemical synthesis.</td> <td></td> <td>✓</td> </tr> <tr> <td>All of the hydrocarbon molecules can be burned as fuels.</td> <td></td> <td></td> </tr> <tr> <td>All of the hydrocarbon molecules can be polymerised,</td> <td></td> <td>✓</td> </tr> </tbody> </table>		true	false	There are hydrocarbon molecules of many different sizes.	✓		Most of the hydrocarbon molecules are used for chemical synthesis.		✓	All of the hydrocarbon molecules can be burned as fuels.			All of the hydrocarbon molecules can be polymerised,		✓	2	<p>ignore the greyed-out row</p> <p>three correct ticks = 2 marks two or one correct ticks = 1 mark zero correct ticks = 0 marks</p> <p>mark ticks in True boxes and crosses in False boxes as though all are ticks</p>
	true	false																	
There are hydrocarbon molecules of many different sizes.	✓																		
Most of the hydrocarbon molecules are used for chemical synthesis.		✓																	
All of the hydrocarbon molecules can be burned as fuels.																			
All of the hydrocarbon molecules can be polymerised,		✓																	

Question	Answer	Marks	Guidance
(c)	<p>(Level 3) Answer uses ideas about how molecules are arranged in liquids and gases, the forces between molecules and the energy required to break these forces to explain the relationship between molecular size and boiling points. Quality of written communication does not impede communication of the science at this level. (5–6 marks)</p> <p>(Level 2) Answer recognises the relationship between molecular size and boiling points and makes an attempt to explain it. Quality of written communication partly impedes communication of the science at this level. (3–4 marks)</p> <p>(Level 1) Answer recognises the relationship between molecular size and boiling points and gives some more information relevant to the question. Quality of written communication impedes communication of the science at this level. (1–2 marks)</p> <p>(Level 0) Insufficient or irrelevant science. Answer not worthy of credit. (0 marks)</p>	6	<p>This question is targeted at grades up to C</p> <p>Indicative scientific points may include:</p> <ul style="list-style-type: none"> • hydrocarbons in crude oil have different chain lengths/different sized molecules • bitumen has the largest molecules and fuel gas the smallest • as size of molecules increases the boiling temperature increases • particles in liquids are closer together • particles in gases are further apart • forces between particles in liquids are stronger than between particles in gases • the bigger the molecules, the larger the forces between them • forces between molecules have to be broken for them to go from liquid to gas • the larger the forces the more energy is needed to break them • more energy requires a higher temperature, therefore boiling point is higher <p>Use the L1, L2, L3 annotations in Scoris; do not use ticks.</p>
	Total	9	

Question		Answer	Marks	Guidance	
5	(a)	<p>(Level 3) Answer comprehensively presents both sides of the argument concerning the risks of using plasticized PVC with valid points to support each argument. Reasons for difference of opinion are given. Quality of written communication does not impede communication of the science at this level. (5–6 marks)</p> <p>(Level 2) Answer explains why people think there is either a high OR a low risk from using plasticized PVC with valid points to support this argument OR presents some ideas for both arguments. Quality of written communication partly impedes communication of the science at this level. (3–4 marks)</p> <p>(Level 1) Answer includes some ideas of possible plasticizer problems/benefits. Quality of written communication impedes communication of the science at this level. (1–2 marks)</p> <p>(Level 0) Insufficient or irrelevant science. Answer not worthy of credit. (0 marks)</p>	6	<p>This question is targeted at grades up to A*</p> <p>Indicative scientific points may include:</p> <ul style="list-style-type: none"> • plasticizers have been shown to cause harm to rats • plasticizers can leach/diffuse out of PVC and into food etc • harmful chemicals can persist in the environment • harmful chemicals can accumulate in food • harmful chemicals can accumulate in human tissue • plasticizer concentrations in humans/environment are very low/below EU limits • data on harmful effects is not conclusive • data from animals may not indicate what is true for humans • using plasticizers has benefits with examples • most people do not know enough to be worried • manufacturers/scientists working for manufacturers have vested interests • pressure groups/manufacturers may have biased views • some people may perceive the risk as higher than it really is • some people think benefit outweighs risk but others think the opposite <p>Use the L1, L2, L3 annotations in Scoris; do not use ticks.</p>	
	(b)	(i)	C (1)	1	if more than one answer given = 0
		(ii)	A (1)	1	if more than one answer given = 0

Question		Answer	Marks	Guidance
	(c)	<p>The probability that you may suffer ... <input checked="" type="checkbox"/> (1)</p> <p><input type="checkbox"/></p> <p><input type="checkbox"/></p> <p>What harmful effects plasticizers ... <input checked="" type="checkbox"/> (1)</p> <p><input type="checkbox"/></p> <p><input type="checkbox"/></p>	2	
			Total	10

Question		Answer	Marks	Guidance								
6	(a)	(i)	1	allow salt lowers freezing point of water do not credit it contains grit unqualified ignore ideas of low cost / easy to obtain								
		(ii)	1	do not allow it is not clean / it will make you ill allow it is contaminated								
	(b)	(i)	2	allow it makes brine which is pumped/sucked up ignore references to evaporation								
		(ii)	2	allow any reasonable explanation do not allow consequential pollution eg use of fossil fuels in mining / release of gases from electrolysis								
	(iii)	<table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th>Label</th> <th>Chemical</th> </tr> </thead> <tbody> <tr> <td>A</td> <td>chlorine</td> </tr> <tr> <td>B</td> <td>sodium hydroxide</td> </tr> <tr> <td>C</td> <td>sodium chloride</td> </tr> </tbody> </table>	Label	Chemical	A	chlorine	B	sodium hydroxide	C	sodium chloride	2	all 3 correct = 2 marks 1 or 2 correct = 1 mark 0 correct = 0 marks allow words from list only do not allow formulae
Label	Chemical											
A	chlorine											
B	sodium hydroxide											
C	sodium chloride											
	(c)	<p>1 limestone available (to react with salt to make sodium carbonate)</p> <p>2 coal available (to provide heat/energy for process)</p>	2	allow in either order both marks can be scored in spaced marked 1 or in space marked 2 ignore idea that salt is available ignore vague references to other resources available								
Total			10									

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