OCR
RECOGNISING ACHIEVEMENT

GCSE

Chemistry A

General Certificate of Secondary Education

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

Mark Scheme for January 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.

OCR will not enter into any discussion or correspondence in connection with this mark scheme.

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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
words	underlined words must be present in answer to score a mark
ecf	error carried forward
AW/owtte	alternative wording
ORA	or reverse argument

Available in scoris to annotate scripts

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

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

Subject-specific Marking Instructions

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

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 boxes 3 and 4 are required for the mark:

Put ticks (✓) in the two correct boxes.

This would be worth 1 mark.

Put ticks (✓) in the two correct boxes.

This would be worth 0 marks.

Put ticks (✓) in the two correct boxes.

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 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, e.g. 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.

e.g. 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**

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

d. 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.

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Question			Answer	Marks	Guidance
1	(a)		as the concentration of particulates **increases** the number of people seeking medical attention (for asthma) **increases** / the higher the concentration of particulates the more people seek medical attention (for asthma) (1)	1	**allow** goes up etc. for increases **allow** decreases … decreases **allow** goes down etc for decreases **allow** there is a positive correlation
	(b)		**[Level 3]** Balance is for low confidence. Answer includes suggestions that will have an effect upon the confidence in the claim. Links each suggestion to the level of confidence. Quality of written communication does not impede communication of the science at this level. (5 – 6 marks) **[Level 2]** Decision can favour high or low confidence. Answer includes some suggestions that affect the confidence in the claim with some idea of how they affect it. Quality of written communication partly impedes communication of the science at this level. (3 – 4 marks) **[Level 1]** Answer includes comments about what may affect the confidence in the claim. Quality of written communication impedes communication of the science at this level. (1 – 2 marks) **[Level 0]** Insufficient or irrelevant science. Answer not worthy of credit. (0 marks)	6	**This question is targeted at grades up to C** **Confidence is low because:** • correlation does not mean cause • there could be other causes • no peer review • so opinions of other scientists have not been given • explanation of why peer review important • no reproducibility of data • so this set of results may not be a 'one off' • journalist is not a scientist • journalist could be biased • so may have his/her own interpretation of data • data not repeated • so may not be reproducible • only one town has been investigated • data from other towns may disagree with this data • more evidence is needed **Claim may be correct because:** • there is a clear correlation • so asthma could be caused by particulates • points are all close to straight line • there are no anomalies/outliers • so conclusions from data will have some validity **Use the L1, L2, L3 annotations in Scoris; do not use ticks.**

Question			Answer	Marks	Guidance
1	(c)		fuels are hydrocarbons / fuels contain carbon; (1) when insufficient oxygen available / when combustion is incomplete (1) carbon/particulates formed instead of carbon dioxide / carbon does not react with oxygen / unburned carbon is left over (1)	3	**do not credit** 'carbon/particulates are formed' without qualification **allow** 'carbon formed as well as carbon dioxide' as long as answer is about incomplete combustion **do not allow** 'carbon particulates do not react with oxygen'
	(d)	(i)	(carbon/particulates/they) deposit/settle/stick/fall on surfaces/buildings/walls/ground (1)	1	**ignore** 'they are breathed in' **reject** photosynthesis **allow** 'they fall/settle as soot'
		(ii)	surfaces/buildings/walls look dirty/black/sooty (1)	1	
			Total	**12**	

Question			Answer	Marks	Guidance
2	(a)		**[Level 3]** Answer includes accurate calculation of average as best estimate and identifies this is above limit (or gives rationale that answer is to 2 sig fig therefore 40 and says this is on limit). Arguments for high AND low confidence considered and reasoned judgement made. Quality of written communication does not impede communication of the science at this level. (5 – 6 marks) **[Level 2]** Answer includes calculation of average as best estimate and identifies this is above limit (or on limit if rounded to 40). Confidence recognised as either high OR low with some idea of justification. Quality of written communication partly impedes communication of the science at this level. (3 – 4 marks) **[Level 1]** Answer includes calculation of average as best estimate and identifies this is above limit (or on limit if rounded to 40), OR makes valid comment about limit (eg some values above 40). Quality of written communication impedes communication of the science at this level. (1 – 2 marks) **[Level 0]** Insufficient or irrelevant science. Answer not worthy of credit. (0 marks)	6	**This question is targeted at grades up to A/A*** **Calculation may include:** • mean/average calculated as best estimate of true value • mean/average = 40.4 (allow 40.375 or 40.38) • best estimate of true value is above limit • mean may be rounded to 40 so best estimate on limit **Confidence above limit is high because** • small range • no outliers • measurements repeated (8 times) • data includes values above 40 • more values above 40 than below **Confidence above limit is low because:** • true value may still not be above 40 • there are some values below 40 / not all are above 40 • range is 38 to 43 so true value could be below 40 • data may only be from one site in town centre • this site may not be representative of the whole of the town • true value could be different if samples taken from whole town centre. • measurements made at only 8 times during the day • concentration could vary between these times • other factors may affect the measurements **Use the L1, L2, L3 annotations in Scoris; do not use ticks.**
	(b)		water/H_2O and oxygen/O_2 (1)	1	both required, either order **do not allow** moisture/rain **allow** water vapour formulae must be completely correct

Question			Answer	Marks	Guidance
2	(c)		BFE (3)	3	**BFE** in correct order = 3 marks **accept AFE** for 2 marks **accept BED** for 1 mark
			Total	**10**	

Question			Answer	Marks	Guidance
3	(a)		stiffness (1)	1	**accept** other indications for answer e.g. underline no mark if two or more words chosen
	(b)		it is an outlier / it is **much** higher than the others / anomalous (1) there is no logical reason for the values to vary this much so it must be discarded / the value is outside the variation expected when measuring the same polymer (1)	2	

<table>
<tr><th colspan="3">Question</th><th>Answer</th><th>Marks</th><th>Guidance</th></tr>
<tr><td>3</td><td>(c)</td><td>(i)</td><td>[Level 3]
Answer identifies difference in flexibility of the polymers related to crystallinity and fully explains at the molecular level how this affects several polymer properties. Quality of written communication does not impede communication of the science at this level.
(5 – 6 marks)
[Level 2]
Answer identifies which is the more crystalline/flexible polymer and attempts some explanation, on the molecular level, of polymer properties. Quality of written communication partly impedes communication of the science at this level.
(3 – 4 marks)
[Level 1]
Answer identifies which is the more crystalline polymer and relates this to flexibility OR wrongly identifies which polymer is more crystalline/less flexible but makes a valid comment about polymer properties. Quality of written communication impedes communication of the science at this level.
(1 – 2 marks)
[Level 0]
Insufficient or irrelevant science. Answer not worthy of credit.
(0 marks)</td><td>6</td><td>This question is targeted at grades up to A

Indicative scientific points may include:
• polymer B is less flexible
• polymer B is more crystalline
• molecules/chains longer
• molecules/chains have more cross links
• molecules/chains closer together
• molecules/chains packed more tightly
• molecules/chains have stronger attraction to each other
• molecules/chains need more energy to separate
• more force needed to slide molecules/chains past
• more crystalline polymer will be harder because molecules/chains packed closer
• more crystalline polymer has higher melting point because molecules/chains need more energy to separate
• more crystalline polymer is more dense because molecules/chains packed closer
• polymer A may have had plasticizer added
accept reverse arguments for polymer A being the less crystalline and so more flexible polymer
ignore reference to strength

Use the L1, L2, L3 annotations in Scoris; do not use ticks.</td></tr>
<tr><td></td><td>(c)</td><td>(ii)</td><td><table><tr><td>Polymer A has fewer cross-links than polymer B.</td><td>✓</td></tr><tr><td>Polymer A has less plasticizer than polymer B.</td><td></td></tr><tr><td>Polymer A has shorter chains than polymer B.</td><td>✓</td></tr></table></td><td>1</td><td>both ticks required for one mark</td></tr>
</table>

Question			Answer	Marks	Guidance
3	(d)		A/C/D because flexible so will not break easily / B because rigid so will not bend while in use / because rigid so stays straight/can be used to draw a straight line (1)	1	choice does not matter but valid reason for that choice scores the mark **ignore** answers related to strength
	(e)		chains made too short / chains not cross linked / chains have less cross-linking / plasticizer has mistakenly been added / too much plasticizer used (1)	1	
	(f)		**any two from:** plastic rulers are easy to mould but wood has to be cut; plastic has a more consistent composition than wood; plastic can be coloured; plastic can be made transparent; plastic can be more flexible than wood; plastic does not rot/lasts longer/more durable; plastic does not cause splinters; plastic is waterproof; you can change the properties of plastic (1)	2	**allow** any reasonable advantage **ignore** cheaper / lighter / stronger
			Total	**14**	

<table>
<tr><th colspan="3">Question</th><th>Answer</th><th>Marks</th><th>Guidance</th></tr>
<tr><td>4</td><td>(a)</td><td></td><td>use / control / production / alteration of properties (1)
particles/structures that are very small/tiny / at molecular level / 10^{-9} m / one billionth of a metre (1)</td><td>2</td><td>use/control/production must be linked to nanotechnology
idea must indicate very small particles not just small particles, or particles measured by a few nanometres (up to 100)</td></tr>
<tr><td></td><td>(b)</td><td>(i)</td><td>sports equipment / socks / sun-cream / first aid plasters / self cleaning windows / scratch resistant coatings on spectacles / washing machines / face creams / cosmetics / medicines / medical equipment / fabrics (1)</td><td>1</td><td>allow other correct examples</td></tr>
<tr><td></td><td></td><td>(ii)</td><td>improvement to match answer in (b)(i) e.g. antibacterial properties / to make stronger (1)</td><td>1</td><td>answer must match that in (b)(i)</td></tr>
<tr><td></td><td>(c)</td><td></td><td><table>
<tr><td>Nanoparticles do not occur in nature.</td><td></td></tr>
<tr><td>Nanoparticles have a smaller surface area than larger particles.</td><td></td></tr>
<tr><td>The effects of nanoparticles have not yet been fully investigated.</td><td>✓</td></tr>
<tr><td>Nanoparticles are larger than 1000 mn.</td><td></td></tr>
<tr><td>Nanoparticles may be harmful to health.</td><td>✓</td></tr>
<tr><td>Nanoparticles are too small to be seen by the unaided eye.</td><td></td></tr>
</table></td><td>2</td><td>one mark for each correct tick</td></tr>
<tr><td></td><td></td><td></td><td>Total</td><td>6</td><td></td></tr>
</table>

<table>
<tr><th colspan="3">Question</th><th>Answer</th><th>Marks</th><th>Guidance</th></tr>
<tr><td>5</td><td>(a)</td><td></td><td>salt eroded from rocks washed into sea / sea erodes salt from rocks (1)
(sea) water evaporated (to leave salt deposits) (1)
tectonic plates moved continents / there was continental drift (1)
area that was originally tropical sea/near equator (is now in NW England) (1)</td><td>4</td><td>allow idea that sea (water) contains salt but do not allow ‘brine’ for sea (water)
do not allow ‘dried up’, do not credit evaporation of water underground</td></tr>
<tr><td></td><td>(b)</td><td>(i)</td><td><table><tr><td>Sulfuric acid is a strong acid that harms living things.</td><td></td></tr><tr><td>Hydrogen chloride is an acidic gas that is very harmful.</td><td>✓</td></tr><tr><td>Sodium sulfate is a poisonous chemical.</td><td></td></tr><tr><td>The carbon used was in the form of coke.</td><td></td></tr><tr><td>Calcium sulfide is a solid waste that gives off poisonous hydrogen sulfide gas.</td><td>✓</td></tr><tr><td>Carbon dioxide is an acidic gas that is toxic.</td><td></td></tr></table></td><td>2</td><td>one mark for each correct tick</td></tr>
<tr><td></td><td></td><td>(ii)</td><td>hydrogen chloride (gas) / HCl</td><td>1</td><td>do not allow hydrochloric acid / hydrogen chlorine
formula must be completely correct</td></tr>
<tr><td></td><td></td><td>(iii)</td><td>sodium sulfate / Na_2SO_4 (1)
carbon dioxide / CO_2 (1)
water / H_2O (1)</td><td>3</td><td>any order
allow sodium sulphate for sodium sulfate
allow salt (sodium sullfate) but not salt on its own
do not allow sodium sulfide / sodium sulfite
do not allow carbon oxide / carbon monoxide / water vapour
to score a mark for a formula it must be completely correct</td></tr>
<tr><td></td><td></td><td></td><td>Total</td><td>10</td><td></td></tr>
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<table>
<tr><th colspan="3">Question</th><th>Answer</th><th>Marks</th><th>Guidance</th></tr>
<tr><td>6</td><td>(a)</td><td></td><td>fall in cases after chlorination introduced/after 1920 (1)

plus any two from:
little or no decline/level was fairly consistent/level was high/went up and down before1920/before chlorine added;
quicker then slower fall in cases (from 1920);
very few/almost no cases by 1960 / falls to almost zero (1)

plus any one from:
chlorine kills the microbes that cause typhoid / sterilises the water;
chlorination gradually introduced / some infection came from other sources (1)</td><td>4</td><td>ignore antiseptic</td></tr>
<tr><td></td><td>(b)</td><td>(i)</td><td>chlorine may react with organic materials (1)
to produce harmful chemicals / to produce chemicals that may cause cancer (1)</td><td>2</td><td>ignore toxic effects of chlorine
accept forms trihalomethanes (THMs)
do not credit 'causes cancer' unqualified</td></tr>
<tr><td></td><td>(b)</td><td>(ii)</td><td><table><tr><td>Chlorine is a very poisonous chemical.</td><td></td></tr><tr><td>Diseases spread by other methods than through drinking water.</td><td></td></tr><tr><td>There is a high risk of death from some of the diseases spread through drinking water.</td><td>✓</td></tr><tr><td>Incidence of typhoid is very rare in industrialised countries.</td><td></td></tr><tr><td>The harmful side effects of chlorination pose only a small risk to health.</td><td>✓</td></tr></table></td><td>2</td><td>one mark for each correct tick</td></tr>
<tr><td></td><td></td><td></td><td>Total</td><td>8</td><td></td></tr>
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