



## **GCSE**

### **Chemistry A**

**Unit A172/01: Modules C4, C5, C6 (Foundation Tier)**

General Certificate of Secondary Education

### **Mark Scheme for June 2016**

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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
<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

<input type="checkbox"/> L1 <input type="checkbox"/> L2 <input type="checkbox"/> L3	draw attention to particular part of candidate's response
<input type="checkbox"/> A	information omitted

## 2. Subject-specific Marking Instructions

- Accept any clear, unambiguous response (including mis-spellings of scientific terms if they are *phonetically* correct, but always check the guidance column for exclusions).
- 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"/>

*This would be worth  
1 mark.*

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

*This would be worth  
0 marks.*

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

*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	✓	✗	✓	✓	✓				✓	
Paris				✓	✓		✓	✓	✓	
Southampton	✓	✗		✓		✓	✓		✓	
<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		<p><b>2 from:</b> they are (alkali) metals;</p> <p>correct physical property of metals e.g. conduct electricity/are shiny/are grey/ are soft;</p> <p>have low MP or BP or density <u>compared to other metals</u>;</p> <p>very reactive / react quickly / react violently;</p> <p>react with water / fizz in water / float on water / produce hydrogen or a gas in water / produce an alkali/hydroxide with water;</p> <p>react with oxygen/air / tarnish in air;</p> <p>react with chlorine / react with halogens / form halide salts;</p>	2	<p><b>ignore</b> references to electrons or atomic structure</p> <p><b>ignore</b> 'are solids'</p> <p><b>Ignore</b> references to MP / BP / density alone</p> <p>Must mention 'water'</p>
	b	i	1, 19, 35.5;	1	All 3 required for the mark
		ii	(atomic mass <b>if</b> it) increases;	1	<p><b>Allow</b> increase by 8 each time if ecf from use of atomic number in bi</p> <p><b>Ignore</b> references to across/down etc the table</p> <p><b>Reject</b> incorrect numerical increases e.g. doubling</p>
		iii	H is on its own/not in a group;  F and Cl are in Group 7;	2	<p><b>Allow</b> not in actual table / above the table /on top of table</p> <p><b>Ignore</b> references to periods or rows</p> <p><b>Allow</b> column 7</p> <p><b>Ignore</b> same group/column</p>
		iv	Group 0;	1	
		v	Elements not discovered;	1	
		vi	Be; B	2	<p><b>Reject</b> BE</p> <p><b>Allow</b> (1) if both correct names given instead of symbols</p>
c			The proton number	1	
				Total	11

Question	Answer	Marks	Guidance
2	<p><b>[Level 3]</b> Makes correct statements about <b>all</b> three minerals AND explains why there is not enough information to identify B/C. Quality of written communication does not impede communication of the science at this level. (5 – 6 marks)</p> <p><b>[Level 2]</b> Makes correct statements about <b>all</b> three minerals <b>OR</b> Explains why B/C cannot be identified Quality of written communication partly impedes communication of the science at this level. (3 – 4 marks)</p> <p><b>[Level 1]</b> Makes a correct statement about the element in <b>two</b> minerals. 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 E</b></p> <p><b>Indicative scientific points may include:</b></p> <p><b>Statements about elements in the minerals</b></p> <ul style="list-style-type: none"> <li>• A contains sodium</li> <li>• B contains potassium/rubidium</li> <li>• C – can't tell idea/other metal ion suggested</li> <li>• None of the minerals contain lithium</li> <li>• green colour may indicate copper/barium</li> <li>• C is not a group 1 element</li> </ul> <p><b>Explanation</b></p> <ul style="list-style-type: none"> <li>• potassium and rubidium have the same colour flame/can't tell the difference</li> <li>• Green colour is not in table</li> <li>• Idea of needs a reference for the green colour</li> </ul> <p><b>Use the L1, L2, L3 annotations in RM Assessor; do not use ticks.</b></p>
	<b>Total</b>	<b>6</b>	

Question		Answer			Marks	Guidance												
3	a	<table> <thead> <tr> <th>colour</th> <th>element</th> <th>state</th> </tr> </thead> <tbody> <tr> <td>grey</td> <td>chlorine</td> <td>solid</td> </tr> <tr> <td>green</td> <td>bromine</td> <td>liquid</td> </tr> <tr> <td>orange</td> <td>iodine</td> <td>gas</td> </tr> </tbody> </table>			colour	element	state	grey	chlorine	solid	green	bromine	liquid	orange	iodine	gas	3	All correct (3) 4/5 lines correct (2) 2/3 lines correct (1)
colour	element	state																
grey	chlorine	solid																
green	bromine	liquid																
orange	iodine	gas																
	b	<p>i neutrons;</p>			1	<b>Reject</b> newtons/neurons												
	ii	<p>Inner shell 2; Outer shell 7;</p>			2													
		<b>Total</b>			<b>6</b>													

Question		Answer	Marks	Guidance
4	a	<p><b>[Level 3]</b> Links a property for both solid <b>and</b> solution to arrangement and/or movement of particles. Quality of written communication does not impede communication of the science at this level. (5 – 6 marks)</p> <p><b>[Level 2]</b> Links a property of solid <b>OR</b> solution to ideas about arrangement and/or movement of particles. Quality of written communication partly impedes communication of the science at this level. (3 – 4 marks)</p> <p><b>[Level 1]</b> Makes a correct statement about arrangement and/or movement of particles for solid <b>OR</b> 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 C</b> <b>Indicative scientific points may include:</b></p> <p><b>Properties and explanation (points relevant to) solid</b></p> <ul style="list-style-type: none"> <li>• Hard/solid because of strong forces/attraction/ bonds</li> <li>• high MP/BP due to strong forces/attraction/bonds</li> <li>• does not conduct electricity because <u>ions/particles</u> cannot move</li> </ul> <p><b>(points relevant to) solution</b></p> <ul style="list-style-type: none"> <li>• liquid because particles can move/flow</li> <li>• liquid/low melting point because ions spread out (in the water) / weak forces / have less attraction /weak bonds/ water gets between ions/particles</li> <li>• conduct electricity because <u>ions/charged</u> particles can move</li> </ul> <p><b>Arrangement and movement of Ions/particles in solid</b></p> <ul style="list-style-type: none"> <li>• arranged in regular rows / 3D / lattice</li> <li>• cannot move/vibrate in place</li> <li>• strong forces/attraction/ bonds</li> </ul> <p><b>Ions/particles in solution</b></p> <ul style="list-style-type: none"> <li>• can move</li> <li>• random arrangement</li> <li>• spread out/separate</li> <li>• mixed with water molecules</li> <li>• weak forces / attraction / bonds</li> </ul> <p><b>Do NOT allow</b> electron movement to explain conductivity <b>Incorrect word</b> e.g. molecule or atom limits QWC at L2 and L3. <b>If no reference to particles of any sort then L1 only</b> <b>Use the L1, L2, L3 annotations in RM Assessor; do not use ticks.</b></p>

Question			Answer	Marks	Guidance
4	b	i	decreases by 3 ( $^{\circ}\text{C}$ ) ; for every 5.0 (g) added; <b>Allow (1) mark for....</b> as mass increases, freezing point decreases / more salt added the lower the temperature ;	2	<b>Allow</b> 'melting point' as AW for 'freezing point'  <b>Ignore</b> 'gets colder' <b>Mass and freezing point</b> show a negative correlation/are inversely proportional (1)
		ii	-15 (2)  If answer incorrect: Working showing correct use of -3/3	2	<b>Ignore</b> -3 as answer with no working
	c	i	Freezing point/temperature is higher than expected/freezing point should be lower;	1	<b>ALLOW</b> same as for 10g/should be -21 <b>Ignore</b> does not fit pattern
		ii	Repeat the experiment again;	1	<b>Ignore</b> draw graph
		iii	measure/take/record the freezing point (for another experiment);  Add a range of salt masses to water / 35g, 45g, 50g;  Use 100cm <sup>3</sup> water/same amount every time;	3	Need at least two different salt masses or 'range' idea <b>Ignore</b> 'add more' or 'add 50' alone
			<b>Total</b>	<b>15</b>	
Question			Answer	Marks	Guidance
5	a		oxygen is a gas / MP and BP below room temperature;  Potassium chloride is soluble / washes away idea;	2	<b>Ignore</b> solubility of oxygen  <b>Reject</b> potassium alone
	b		C <b>and</b> O <sub>2</sub> (1)  potassium <b>and</b> chlorine (1)	2	<b>Reject</b> O, 2O, O <sub>2</sub> , O <sup>2</sup>  <b>Reject</b> potassium chloride
			<b>Total</b>	<b>4</b>	

Question	Answer	Marks	Guidance
6	<p><b>[Level 3]</b>            Draws both diagrams with basic features for NaCl and KCl with correct direction of energy change <b>and</b> shows or comments on relative size of energy change for all diagrams.            Quality of communication does not impede communication of the science at this level.            (5 – 6 marks)</p> <p><b>[Level 2]</b>            Draws both diagrams with basic features and either comments on or shows correct direction of energy change for NaCl/KCl .            Quality of written communication partly impedes communication of the science at this level.            (3 – 4 marks)</p> <p><b>[Level 1]</b>            Draws product lines in same direction for <u>both</u> diagrams or makes a correct statement about a temperature or 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>		<p><b>This question is targeted at grades up to C</b>  <b>Indicative scientific points may include:</b></p> <p><b>Basic features</b></p> <ul style="list-style-type: none"> <li>Line drawn with products labelled (for L1 direction does not have to be correct)</li> <li>energy change arrow starts at level of reactants and ends with point at level of products</li> </ul> <p><b>Consider QWC impeded</b> if products not labelled <b>or</b> energy arrow not drawn with single arrow pointing at products (ie double ended arrow or single line)</p> <p><b>Diagram features all levels:</b></p> <ul style="list-style-type: none"> <li>product line drawn <u>above</u> reactants for both NaCl and KCl)</li> <li>Size of energy change KCl bigger than NaCl</li> <li>Size of energy change LiCl is biggest</li> </ul> <p><b>Allow</b> (5) if KCl change is not obviously smaller than LiCl</p> <p><b>Temperature and energy changes (written statements)</b></p> <ul style="list-style-type: none"> <li>Exothermic reactions give out energy (e.g LiCl)/ endothermic reactions take in energy (e.g. NaCl/KCl)</li> <li>Bigger temperature change means more energy in/out</li> <li>LiCl exothermic AND NaCl AND KCl endothermic</li> <li>LiCl temperature increases</li> <li>LiCl energy given out / products have less energy than reactants</li> <li>NaCl/KCl temperature decreases</li> <li>NaCl/KCl energy taken in/ products have more energy than reactants</li> <li>LiCl gives biggest temperature change</li> <li>LiCl gives biggest energy change</li> <li>Temperature change for KCl is bigger than NaCl</li> <li>Energy change for KCl is bigger than NaCl</li> </ul> <p><b>Use the L1, L2, L3 annotations in RM Assessor; do not use ticks.</b></p>
		6	

Question		Answer	Marks	Guidance
7	a	acids have pH below 7; alkalis have pH above 7;	2	If neither mark awarded: <b>allow</b> 1 mark for idea of looking at numbers / number(s) quoted <b>Ignore</b> reference to colours
	b	sodium hydroxide and/or calcium hydroxide have ionic bonding; ammonia has covalent bonding;	2	If neither mark awarded: <b>allow</b> 1 mark for idea of both ionic and covalently bonded alkalis
	c	<div style="display: flex; justify-content: space-around; align-items: flex-end;"> <div style="border: 1px solid black; padding: 2px;">solid sodium hydroxide</div> <div style="border: 1px solid black; padding: 2px;">(g)</div> </div> <div style="display: flex; justify-content: space-around; align-items: flex-end;"> <div style="border: 1px solid black; padding: 2px;">hydrogen chloride gas</div> <div style="border: 1px solid black; padding: 2px;">(l)</div> </div> <div style="display: flex; justify-content: space-around; align-items: flex-end;"> <div style="border: 1px solid black; padding: 2px;">liquid ethanoic acid</div> <div style="border: 1px solid black; padding: 2px;">(s)</div> </div> <div style="display: flex; justify-content: space-around; align-items: flex-end;"> <div style="border: 1px solid black; padding: 2px;">solution dissolved in water</div> <div style="border: 1px solid black; padding: 2px;">(aq)</div> </div>	2	All correct (2) 2 or 3 correct (1)
			Total	6

Question		Answer	Marks	Guidance
8	a	<p>silver nitrate + sodium chloride → silver chloride + sodium nitrate</p> <p>Fully correct (2)</p> <p>silver nitrate on LHS and silver chloride on RHS; (1)</p>	2	<p><b>allow</b> (1) for correct names written under formulae with no '+' or '→'</p>
	b	<p>filter paper goes into funnel;</p> <p>filter off solid / idea that solid or silver chloride is in filter paper/washing of solid;</p> <p>solid is dried (in oven);</p>	3	<p><b>Check diagram</b> for indication of MP1 and/or 2</p> <p>Do not allow MP3 if oven is used before filtration/filtration not mentioned.</p> <p><b>Allow</b> filter paper into oven to dry</p>
	c	chlorine	1	
			<b>Total</b>	<b>6</b>

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