

# Markscheme

May 2017

Chemistry

On-screen examination

15 pages

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The following are the annotations available to use when marking responses.

Annotation	Explanation	Shortcut	Annotation	Explanation	Shortcut
	Correct point, place at the point in the response where it is clear that the candidate deserves the mark	Alt+1		No benefit of the doubt	Alt+4
AEr	Arithmetic error		NEX	No explanation given	
	Benefit of the doubt	Alt+3		Not good enough	
	Omission, incomplete	Alt+7		Not worthy of any marks	
CON	Contradiction	Alt+6	NWS	No working shown	
	Valid part (to be used when more than one element is required to gain the mark)			Test box used for additional marking comments	
	Error carried forward	Alt+8		Unclear	Alt+2
	Dynamic annotation, it can be expanded to surround work			Seen; must be stamped on all blank response areas	Alt+9
	Horizontal wavy line that can be expanded			Vertical wavy line that can be expanded	
	Highlight tool that can be expanded to mark an area of a response			Words to that effect	
	Not answered the question				

## Markscheme instructions

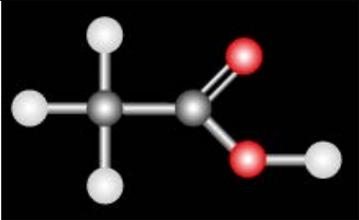
- 1 Mark positively. Give candidates credit for what they have achieved and what is correct. Do not deduct marks for incorrect responses.
- 2 Follow the markscheme provided and award only whole marks.
- 3 Each marking point appears on a separate line.
- 4 The maximum mark for each subpart is indicated in the “Total” column.
- 5 Where a mark is awarded a tick should be placed in the text at the precise point where it is clear the candidate deserves the mark.
- 6 Each marking point in a question part should be awarded separately unless there is an instruction to the contrary in the Notes column.
- 7 A question subpart may have more marking points than the total allows. This will be indicated by the word “**max**” in the Answer column. Further guidance may be given in the Notes column.
- 8 Additional instructions on how to interpret the markscheme are in bold italic text in the Answer column.
- 9 Alternative wording may be indicated in the Answer column by a slash (/). Either alternative is equally acceptable but the candidate cannot be rewarded for both as they are associated with the same marking point.
- 10 Alternative answers are indicated in the Answer column by “**or**”. Either alternative is equally acceptable but the candidate cannot be rewarded for both as they are associated with the same marking point.
- 11 If two related points are required to award a mark, this is indicated by “**and**” in the answer column.
- 12 Words in brackets ( ) in the Answer column are not necessary to gain the mark.
- 13 Words that are underlined are essential for the mark.

- 14 In some questions a reverse argument is also acceptable. This is indicated by the abbreviation *ORA* (or reverse argument) in the Notes column. Candidates should not be rewarded for reverse arguments unless *ORA* is given in the Notes column.
- 15 If the candidate's response has the same meaning or is clearly equivalent to the expected answer the mark should be awarded. In some questions this is emphasized by the abbreviation *WTTE* (words to that effect) in the Notes column.
- 16 When incorrect answers are used correctly in subsequent question parts the follow through rule applies. Award the mark and add *ECF* (error carried forward) to the candidate response.
- 17 The order of marking points does not have to be the same as in the Answer column unless stated otherwise.
- 18 Marks should not be awarded where there is a contradiction in an answer. Add *CON* to the candidate response at the point where the contradiction is made.
- 19 Do not penalize candidates for errors in units or significant figures unless there is specific guidance in the Notes column.
- 20 Questions with higher mark allocations will generally be assessed using a level response method using task specific clarifications developed with reference to the criteria level descriptors. Candidate's work should be marked using a best fit approach. A candidate's response should be reviewed to determine holistically the band in which the response falls. Once this has been determined, each bullet point within that band should be assessed to see if the candidate has met the requirements of the statement. Where those requirements are met, marks should be awarded, starting from the lowest available mark for that band.

Once this process has been completed if the highest (or lowest) mark available for that band has been determined, the examiner must check the band above (or below) to ensure that the initially correct determination of the band was correctly allocated. For example, there may be sufficient detail in the candidate's response to award the lowest mark of the band above.

**NB. Marks are distributed unevenly across the mark bands as candidates have to include much more detail in their responses to access the highest mark bands.**

Question		Answers	Notes	Marks	Criterion
1	a	Fe <sub>2</sub> O <sub>3</sub> MnO <sub>2</sub>	Accept MnO <sub>2</sub> if subscripts are seen somewhere	2	A
	b	Any transition metal identified by name <b>or</b> symbol other than Mn or Fe  <b>Any two of the following:</b> <ul style="list-style-type: none"> <li>• This is also a transition metal <b>or</b> d block element <b>or</b> group B</li> <li>• variable oxidation states <b>or</b> variable valency</li> <li>• electrons in the d orbital</li> <li>• form coloured compounds <b>or</b> solutions</li> <li>• a named typical metallic property eg malleable, ductile, shiny, sonorous, conductor</li> </ul>		3	A
	c	Emulsion  it is a mixture of powder/pigments/crushed minerals <b>and</b> in water <b>or</b> oil <b>or</b> heterogenous mixture <b>or</b> immiscible mixture <b>or</b> colloid		2	A
	d	A watercolour paint is very soluble in water  Oil paint is not soluble in water  so the watercolour paint will be washed away		3	A
	e	A statement about the effect of one type of paint on the environment with a valid reason  <b>Any three relevant, further points, for example (3 max)</b> <ul style="list-style-type: none"> <li>• water soluble paints can enter rivers (and cause pollution)</li> <li>• solvents are not soluble in water so remain in environment</li> <li>• oil-based paints can cause pollution</li> <li>• Solvents are needed to clean oil-based paints</li> </ul>		4	D
	f	<b>Correct balancing:</b> $2 \text{CrO}_4^{2-} + 10 \text{H}^+ + 6\text{e}^- \rightarrow \text{Cr}_2\text{O}_3 + 5 \text{H}_2\text{O}$  Correct coefficients on one side of the equation  All coefficients are correct	Accept 10 H	2	A

	<b>g</b>	<p>Reduction</p> <p>because Cr<sup>6+</sup>/Cr (VI) gains electrons  <b>or</b>                      because Cr<sup>6+</sup> / Cr (VI) becomes Cr<sup>3+</sup> / Cr (III)  <b>or</b>                      CrO<sub>4</sub><sup>2-</sup> loses oxygen <b>or</b> gains electrons  <b>or</b>                      the oxidation state/number of chromium decreases</p>	<p><i>Accept chromium oxide on left hand side</i></p>	<b>2</b>	A
<b>2</b>	<b>a</b>	 <p>methyl group or carboxyl group correctly displayed</p> <p>correct structure for ethanoic acid</p> <p>carboxyl group correctly named</p>	<p><i>Remember to scroll down to see the response box for the name of the functional group</i></p> <p><i>Only award this mark if there is a reasonable attempt at a correct structure</i></p> <p><i>Correct structure scores 2 marks</i></p> <p><i>accept carboxylic acid</i></p>	<b>3</b>	A
	<b>b</b>	Neutralization		<b>1</b>	A
	<b>c</b>	110 (g/mol <b>or</b> amu)	<i>Units not required</i>	<b>1</b>	A
	<b>d</b>	<p>Molar mass of silver = 108</p> <p>Molar mass of AgBr = 188</p> <p>Final mass needed 3481(g)/ 3.48(kg)</p> <p><b>Any</b> calculated answer to 2 sig figs (3500 (g) 3.5 x 10<sup>3</sup> (g) <b>or</b> 3.5 (kg))</p>	<p><i>ECF from points 1 and 2</i></p> <p><i>Award the sig fig mark independently</i></p>	<b>4</b>	A

3	a	Evaporation		1	A
	b	Water loses heat/energy  Condensation <b>Or</b> Changes from gas/vapour to liquid		2	A
	c	Two essential items from: filter paper, funnel and container  <b>All</b> items selected labelled correctly  Arranged correctly for filtration	<i>If <b>all</b> equipment is selected, award maximum 2 marks</i>  <i>Items can be incorrect for this mark</i>	3	B
	d	high  decreases  ions		3	C
	e	between 20–25 cm <sup>3</sup> of NaCl added there is a sharp drop in conductivity  because the silver ions are reacting <b>or</b> removed <b>or</b> a precipitate is forming	<i>Accept drop in mV</i>	2	C
	f	Conductivity <b>or</b> water purity <b>or</b> number of microbes <b>or</b> amount of microbes  Temperature <b>or</b> same water sample <b>or</b> same equipment	<i>Do <b>not</b> accept references to filter or volume of water as these are given in the question</i>	2	B

<b>g</b>	<ul style="list-style-type: none"> <li>• an attempt at a research question</li> <li>• attempts to plan a method</li> </ul>	1-2		<b>14</b>	<b>B</b>
	<ul style="list-style-type: none"> <li>• research question attempts to link most effective filter with lowest conductivity</li> <li>• plans to measure the conductivity using one purification method</li> <li>• attempt at a method but detail is insufficient for another student to follow</li> </ul>	3-5			
	<ul style="list-style-type: none"> <li>• research question correctly links most effective filter with lowest conductivity</li> <li>• plans to measure the conductivity using two purification methods</li> <li>• equipment to measure volume or temperature is listed</li> <li>• method is described and could easily be followed by another student</li> </ul>	6-9			
	<ul style="list-style-type: none"> <li>• research question correctly links most effective filter with lowest conductivity and justifies this</li> <li>• plans to measure the conductivity using all three purification methods</li> <li>• equipment to measure volume and temperature is listed</li> <li>• complete method is described, fully explained and could easily be followed by another student</li> <li>• plans to repeat process and calculate mean values</li> </ul>	10-14			

4	a	<table border="1"> <thead> <tr> <th>Type of fuel</th> <th>Percentage of different types of fuel use in an urban area / %</th> <th>Percentage of different types of fuel use in a rural area / %</th> </tr> </thead> <tbody> <tr> <td>Wood</td> <td>36.2</td> <td>81.4</td> </tr> <tr> <td>Dung (animal waste)</td> <td>2.5</td> <td>9.4</td> </tr> <tr> <td>LPG</td> <td>41.5</td> <td>3.9</td> </tr> <tr> <td>Biogas</td> <td>3.2</td> <td>2.4</td> </tr> <tr> <td>Crop waste</td> <td>0.2</td> <td>1.8</td> </tr> <tr> <td>Kerosene</td> <td>15.8</td> <td>1.0</td> </tr> <tr> <td>Charcoal</td> <td>0.2</td> <td>0.1</td> </tr> <tr> <td>Electricity</td> <td>0.4</td> <td>0</td> </tr> </tbody> </table>	Type of fuel	Percentage of different types of fuel use in an urban area / %	Percentage of different types of fuel use in a rural area / %	Wood	36.2	81.4	Dung (animal waste)	2.5	9.4	LPG	41.5	3.9	Biogas	3.2	2.4	Crop waste	0.2	1.8	Kerosene	15.8	1.0	Charcoal	0.2	0.1	Electricity	0.4	0			
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	b	<p>Calcium hydroxide solution / <math>\text{Ca}(\text{OH})_2(\text{aq})</math> / Limewater</p> <p>Bubbling through (limewater) <b>or</b> passing through (limewater)</p> <p>(Limewater) will turn white <b>or</b> cloudy <b>or</b> a precipitate <b>or</b> <math>\text{CaCO}_3</math> is formed if <math>\text{CO}_2</math> is present</p>	<p><i>Ignore incorrect formula (eg <math>\text{CaOH}</math>) if calcium hydroxide <b>or</b> limewater are mentioned</i></p> <p><i>WTTE</i></p>	3	B																											
	c	<p><b>Fuels:</b> either wood <b>or</b> dung identified both fuels identified</p> <p><b>variables:</b> volume of <math>\text{CO}_2</math> <b>or</b> gas is measured/dependent variable mass of fuel should be controlled (could be seen as part of method)</p> <p><b>Sufficient data:</b> repeat for both fuels minimum three trials</p> <p><b>method:</b> burn <b>or</b> set on fire <b>or</b> combust fuel collect gas in syringe leave until all fuel is burnt measure volume <b>or</b> amount <b>or</b> quantity of gas produced</p> <p><b>Safety:</b> a safety concern is mentioned</p>	<p><i>Accept "amount"</i></p> <p><i>"Syringe" can be implied</i></p>	11	B																											
	d	<p>All the <math>\text{CO}_2</math> is collected</p> <p><b>Or</b></p> <p>No <math>\text{CO}_2</math> is lost</p>		1	C																											

<b>e</b>	(smoke indicates) incomplete combustion Less CO <sub>2</sub> <b>or</b> unwanted products <b>or</b> smoke (produced) Results are not valid because all of the fuel did not burn	<i>Accept "accurate"</i>	<b>3</b>	<b>C</b>
<b>f</b>	Increase air flow <b>or</b> more oxygen <b>or</b> more air	<i>WTTE</i>	<b>1</b>	<b>C</b>

5	a		<b>Volume of chemical X added</b>		2	C
		First titration ml	(22.75)			
		Second titration ml	(27.25)			
		Average amount of chemical X added ml	25.00			
		Average correctly calculated				
		Correct number of significant figures: 25.00				
	b	1.65 (g) Carbon dioxide		<i>Unit needed for second mark, award this mark independently</i>	2	C
		g				
	c	1.65 x 10 = 16.5 g carbon dioxide		<i>ECF</i>	4	C
		16.5/44 = 0.375 moles				
		0.375 x 22.7 = 8.51				
		dm <sup>3</sup> <i>or</i> l				
				<i>seen or implied</i>		
				<i>award 3 for correct mass</i>		
				<i>unit mark awarded independently</i>		

6	a	<p>data values given in numerical order</p> <p>all volumes converted into cm<sup>3</sup></p> <table border="1" data-bbox="277 355 1227 746"> <thead> <tr> <th>Time / s</th> <th>Volume CO<sub>2</sub> / cm<sup>3</sup></th> </tr> </thead> <tbody> <tr><td>10</td><td>13.0</td></tr> <tr><td>20</td><td>17.3</td></tr> <tr><td>30</td><td>18.4</td></tr> <tr><td>40</td><td>19.2</td></tr> <tr><td>60</td><td>19.8</td></tr> <tr><td>70</td><td>20.1</td></tr> <tr><td>80</td><td>20.4</td></tr> <tr><td>90</td><td>20.5</td></tr> <tr><td>100</td><td>20.9</td></tr> <tr><td>110</td><td>20.1</td></tr> <tr><td>120</td><td>21.1</td></tr> <tr><td>130</td><td>21.2</td></tr> <tr><td>140</td><td>21.3</td></tr> <tr><td>150</td><td>21.3</td></tr> </tbody> </table>	Time / s	Volume CO <sub>2</sub> / cm <sup>3</sup>	10	13.0	20	17.3	30	18.4	40	19.2	60	19.8	70	20.1	80	20.4	90	20.5	100	20.9	110	20.1	120	21.1	130	21.2	140	21.3	150	21.3		2	C
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	b	<p>Graph 1</p> <p>volume of CO<sub>2</sub> against time</p>	<i>WTTE but in this order only</i>	2	C																														
	c	<p>data value at 110s identified</p> <p>21 (cm<sup>3</sup>)</p>	<i>Units required</i>	2	C																														
	d	repeat measurement <b>and</b> calculate average value		1	C																														
7	a	<p>Group 4</p> <p>period 6</p>	<p><i>accept group 14</i></p> <p><i>check group and number are correctly paired</i></p>	2	A																														
	b	good conductivity		1	A																														
	c	<p>low reactivity (with air/water)</p> <p><b>or</b></p> <p>high chemical stability</p>		1	A																														
	d	<p>82 (protons)</p> <p>126 (neutrons)</p>	<p><i>Accept 126n, 82p</i></p> <p><i>Do <b>not</b> accept 126, 82</i></p>	2	A																														

8	<ul style="list-style-type: none"> <li>• lead adversely affects the body</li> <li>• lead levels have changed</li> </ul>	1-2			
	<ul style="list-style-type: none"> <li>• lead adversely affects the body and link to learning difficulties status graph</li> <li>• lead is accumulated in the body</li> <li>• lead levels have decreased over time</li> <li>• suggests an impact on society</li> </ul>	3-6			
	<ul style="list-style-type: none"> <li>• lead adversely affects the body correctly linked to learning difficulties</li> <li>• lead levels have decreased over time since lead was banned</li> <li>• level of lead generally increases with age as it is accumulated in the body</li> <li>• links year of birth with lead levels</li> <li>• reference to the second graph</li> <li>• a suggestion of why children are more sensitive</li> <li>• a wider impact on society</li> <li>• a final appraisal</li> </ul>	7-14			

9	<ul style="list-style-type: none"> <li>• identify their chosen type of battery with a supporting statement</li> </ul>	1			10	D
	<ul style="list-style-type: none"> <li>• identify their chosen type of battery with a valid supporting statement</li> <li>• comparison with at least one other battery implied</li> </ul>	2-3				
	<ul style="list-style-type: none"> <li>• identify their chosen type of battery with more than one valid supporting statement</li> <li>• comparison with at least two other batteries implied</li> <li>• an environmental <b>or</b> economic factor is mentioned</li> </ul>	4-6				
	<ul style="list-style-type: none"> <li>• identify their chosen type of battery with more than two valid supporting statements</li> <li>• comparison of all battery types implied</li> <li>• environmental <b>and</b> economic factors are discussed</li> <li>• a concluding appraisal referring to all factors considered</li> </ul>	7-10				