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**CHEMISTRY**

**9701/05**

Paper 5 Planning, Analysis and Evaluation

**For Examination from 2016**

SPECIMEN MARK SCHEME

**1 hour 15 minutes**

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**MAXIMUM MARK: 30**

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This document consists of **5** printed pages and **1** blank page.

Question	Expected Answer	Additional Guidance	
<b>1 (a)</b>	<b>(i)</b> The temperature The surface area of the marble chips	Allow size of the marble chips	1
	<b>(ii)</b> Measure the temperature of the hydrochloric acid <b>AND</b> Use the same mass and number of marble chips		1
	<b>(iii)</b> The mass of the carbon dioxide	Allow loss in mass of the flask containing the reactants	1
<b>(b)</b>	The diagram shows a container for the marble chips and hydrochloric acid connected to a gas syringe.  All connections are shown such that the apparatus would work without leakage of carbon dioxide.  The apparatus is fully labelled.	Allow collection of carbon dioxide over water  Bungs/corks must be shown where required	1  1  1
	<b>(c)</b> The volume of hydrochloric acid The concentration of the hydrochloric acid The mass of marble chips The time taken to collect 100 cm <sup>3</sup> of carbon dioxide  <b>4 correct 2 marks</b> <b>3 correct 1 mark</b>	Ignore mention of temperature or size of marble chips  Allow final time or time to end of experiment	1  1
	<b>(d)</b> Stated volume of 2.00 mol dm <sup>-3</sup> hydrochloric acid is taken <b>using a pipette/burette</b> and placed in a volumetric flask  Water added to the volumetric flask to make up to the mark <b>AND</b> solution then shaken/flask is inverted several times  The volume of the volumetric flask is four times the volume of hydrochloric acid taken <b>OR</b> the volume of water added is three times the volume of hydrochloric acid taken	Do <b>not</b> allow the use of a measuring cylinder  Volumetric flask must be a conventional size (i.e. allow 25, 50, 100, 150, 200, 250, 500, 1000 or 2000 cm <sup>3</sup> )	1  1  1
<b>(e)</b>	The concentration of the acid must be such that it is the acid and not the marble chips which is controlling the rate of reaction	Allow any wording of the answer which shows an understanding of this point	1

Question	Expected Answer	Additional Guidance	
(f)	The concentration of the hydrochloric acid The inverse of the time taken	Do <b>not</b> allow 'rate' unless this is stated as 1/t	1
<b>Qn 1</b>		<b>Total</b>	<b>15</b>

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<b>2 (a)</b>	<table border="1"> <thead> <tr> <th><b>E</b></th> <th><b>F</b></th> </tr> <tr> <th>Mass of <math>X_2CO_3</math> /g <b>A – B</b></th> <th>Mass of <math>CO_2</math> /g <b>C + E – D</b></th> </tr> </thead> <tbody> <tr><td>2.81</td><td>0.95</td></tr> <tr><td>4.65</td><td>1.45</td></tr> <tr><td>0.90</td><td>0.38</td></tr> <tr><td>5.50</td><td>2.08</td></tr> <tr><td>5.80</td><td>1.84</td></tr> <tr><td>3.70</td><td>1.20</td></tr> <tr><td>2.20</td><td>0.56</td></tr> <tr><td>7.40</td><td>2.15</td></tr> <tr><td>5.24</td><td>1.70</td></tr> <tr><td>6.40</td><td>2.05</td></tr> <tr><td>3.40</td><td>0.90</td></tr> <tr><td>7.32</td><td>2.34</td></tr> </tbody> </table> <p>Correct formulae and units for table heading</p> <p>All values to two decimal places</p> <p>All values correct</p>	<b>E</b>	<b>F</b>	Mass of $X_2CO_3$ /g <b>A – B</b>	Mass of $CO_2$ /g <b>C + E – D</b>	2.81	0.95	4.65	1.45	0.90	0.38	5.50	2.08	5.80	1.84	3.70	1.20	2.20	0.56	7.40	2.15	5.24	1.70	6.40	2.05	3.40	0.90	7.32	2.34	<p>1</p> <p>1</p> <p>1</p>
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<b>(b)</b>	<p>All points plotted correctly</p> <p>Appropriate straight line of best fit drawn (The deviation of points on each side of the best fit line must be nearly the same)</p>	<p>1</p> <p>It is not a requirement that the best fit line extends beyond the range of the data obtained but if the line of best fit is extended it should pass through the origin.</p> <p>1</p>																												

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(c)	<p>The anomalous point chosen must be more than two small squares distant from the line of best fit.</p> <p>If the point identified indicates too much CO<sub>2</sub> produced then this could be because the cotton wool plug was not weighed at the end  <b>OR</b>                      If the point identified indicates too little CO<sub>2</sub> produced then this could be that the solution was not saturated with CO<sub>2</sub> at the start/CO<sub>2</sub> not left long enough to diffuse</p>		1
(d)	Identifies less reliability with lower masses of X <sub>2</sub> CO <sub>3</sub> because percentage errors will be higher	Allow any wording of the answer which shows an understanding of this point	1
(e) (i)	Marks on the graph and gives correct co-ordinates for two points which lie on the line of best fit		1
	Calculates the gradient correctly using the two points	No mark should be awarded if units are given for the gradient	1
(ii)	Explains that the gradient is the mass of CO <sub>2</sub> divided by the mass of X <sub>2</sub> CO <sub>3</sub>		1
	Calculates correctly M <sub>r</sub> of X <sub>2</sub> CO <sub>3</sub> as 44/gradient		1
(f) (i)	No change as the mass is unaffected by a change in temperature		1
(ii)	Line would have a steeper gradient		1
	An equivalent mass of Y <sub>2</sub> CO <sub>3</sub> produces more CO <sub>2</sub> <b>OR</b> an equivalent volume of CO <sub>2</sub> is produced by a smaller mass of Y <sub>2</sub> CO <sub>3</sub>		1
(g)	Use a titration of X <sub>2</sub> CO <sub>3</sub> against HCl	Allow other named strong acid	1
<b>Qn2</b>		<b>Total</b>	<b>15</b>

