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**CHEMISTRY**

**9701/52**

Paper 5 Planning, Analysis and Evaluation

**May/June 2016**

MARK SCHEME

Maximum Mark: 30

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**Published**

This mark scheme is published as an aid to teachers and candidates, to indicate the requirements of the examination. It shows the basis on which Examiners were instructed to award marks. It does not indicate the details of the discussions that took place at an Examiners' meeting before marking began, which would have considered the acceptability of alternative answers.

Mark schemes should be read in conjunction with the question paper and the Principal Examiner Report for Teachers.

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<b>Question</b>	<b>Expected answer</b>	<b>Mark</b>
<b>1 (a)</b>	(As the $E^{\circ}_{\text{cell}}$ value increases) $\Delta H_r$ decreases or $\Delta H_r$ becomes more negative or $\Delta H_r$ becomes more exothermic. AND The more reactive the metal then the greater the energy release will be. OR Energy output of both reactions is dependent upon the difference in reactivity (of metals).	[1]
<b>(b)</b>	Independent variable: The (type of) metal Dependent variable: temperature change or rise or increase OR enthalpy change	[1] [1]
<b>(c) (i)</b>	Diagram should indicate a labelled insulated container AND a labelled thermometer in the liquid.	[1]
<b>(ii)</b>	Mass of metal before and after  Initial temperature (before metal added) AND Highest temperature (after metal added)	[1] [1]
<b>(iii)</b>	Wear gloves	[1]
<b>(iv)</b>	Moles $\text{CuSO}_4 = 0.025 \text{ mol}$ , therefore moles of magnesium = $0.025 \text{ mol}$  (minimum) mass $\text{Mg} > (0.025 \times 24.3 =) 0.6075 \text{ g}$ AND mass required value is greater than $0.6075 \text{ g}$	[1] [1]
<b>(v)</b>	Larger surface area AND causes increased rate of reaction	[1]
<b>(vi)</b>	Ensure uniformity of heating (of solution)	[1]

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<b>Question</b>	<b>Expected answer</b>	<b>Mark</b>
<b>(d)</b>	$50.0 \times 4.18 \times 58.5 = 12\,226.5 \text{ (J)}$ $\Delta H_r = 12\,226.5 / 0.025 = \frac{489\,000}{1000} = -489$	[1] [1]
<b>(e)</b>	Complete circuit involving labelled voltmeter; labelled salt bridge; two separate solutions;  (Solutions are) magnesium sulfate or $\text{MgSO}_4$ with magnesium or Mg rod and copper(II) sulfate $\text{CuSO}_4$ with copper or Cu rod  Concentration of solution(s) is $1 \text{ mol dm}^{-3}$ or 1 M	[1] [1] [1]
<b>(f)</b>	So that values can be compared	[1]
<b>(g)</b>	Both $\Delta H_r$ (Zn) and $\Delta H_r$ (Fe) values which are consistent with the prediction in <b>(a)</b> .	[1]
		<b>[18]</b>

<b>Page 4</b>	<b>Mark Scheme</b>	<b>Syllabus</b>	<b>Paper</b>
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<b>Question</b>	<b>Expected answer</b>	<b>Mark</b>																						
<b>2 (a)</b>	<table border="1"> <thead> <tr> <th>Mass of liquid Y used /g</th> <th>Volume of vapour Y/cm<sup>3</sup></th> </tr> </thead> <tbody> <tr><td>0.15</td><td>48</td></tr> <tr><td>0.10</td><td>35</td></tr> <tr><td>0.21</td><td>72</td></tr> <tr><td>0.17</td><td>58</td></tr> <tr><td>0.24</td><td>83</td></tr> <tr><td>0.09</td><td>31</td></tr> <tr><td>0.20</td><td>70</td></tr> <tr><td>0.23</td><td>79</td></tr> <tr><td>0.12</td><td>41</td></tr> <tr><td>0.22</td><td>73</td></tr> </tbody> </table>	Mass of liquid Y used /g	Volume of vapour Y/cm <sup>3</sup>	0.15	48	0.10	35	0.21	72	0.17	58	0.24	83	0.09	31	0.20	70	0.23	79	0.12	41	0.22	73	
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All mass values.	[1]																							
All volume values.	[1]																							
<b>(b)</b>	Candidate's points plotted correctly from table in 2(a).	[1]																						
	Line of best fit drawn.	[1]																						

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<b>Question</b>	<b>Expected answer</b>	<b>Mark</b>
<b>(c) (i)</b>	Y evaporates from the (hypodermic) syringe OR Y evaporates before injection OR Y evaporates before weighing / after injection	[1]
<b>(ii)</b>	(Stop evaporation by) Keeping the syringe as cool as possible OR Closing off the needle end to stop evaporation OR Minimising length of time between each weighing	[1]
<b>(d) (i)</b>	correct co-ordinates.  correct calculation of the gradient must be <b>three</b> significant figures	[1]  [1]
<b>(ii)</b>	Calculation of $M_r = 3.07 \times 10^4 / \text{gradient in 2(d)(i)}$  Answer	[1]  [1]
<b>(e)</b>	$M_r$ (from mass spectrum) = 84 OR empirical formula = $\text{CH}_2$ OR ratio of C and H seen as 1:2  Y is $\text{C}_6\text{H}_{12}$	[1]     [1]
		<b>[12]</b>