

CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Level

MARK SCHEME for the October/November 2013 series

9701 CHEMISTRY

9701/52

Paper 5 (Planning, Analysis, Evaluation),
maximum raw mark 30

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.

Cambridge will not enter into discussions about these mark schemes.

Cambridge is publishing the mark schemes for the October/November 2013 series for most IGCSE, GCE Advanced Level and Advanced Subsidiary Level components and some Ordinary Level components.

Page 2	Mark Scheme	Syllabus	Paper
	GCE A LEVEL – October/November 2013	9701	52

Question	Expected Answer	Mark				
1 (a) (i)	(The temperature would) decrease The lattice enthalpy is more negative/exothermic than the (sum of the) enthalpies/energies of hydration.	1 1				
(ii)	<div style="display: flex; justify-content: space-around;"> <div style="text-align: center;"> <p>temperature change</p> </div> <div style="text-align: center;"> <p>temp change</p> </div> </div> <p>OR</p> <div style="display: flex; justify-content: space-around;"> <div style="text-align: center;"> <p>25°C temperature</p> </div> <div style="text-align: center;"> <p>25°C temp</p> </div> </div> <p>OR ecf from 1(a)(i)</p> <div style="border: 1px solid black; padding: 5px; margin-top: 10px;"> <p>MARK SCHEME FOR THE EXAMINER'S USE ONLY</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 50%; vertical-align: top;"> <p>Mark for drawing a graph (1 mark)</p> <p>1 mark for drawing a graph with a downward-sloping line.</p> <p>1 mark for drawing a graph with a horizontal line at 25°C, then a downward-sloping line.</p> </td> <td style="width: 50%; vertical-align: top;"> <p>Mark for drawing a graph (1 mark)</p> <p>1 mark for drawing a graph with a downward-sloping line.</p> <p>1 mark for drawing a graph with a horizontal line at 25°C, then a downward-sloping line.</p> </td> </tr> <tr> <td style="vertical-align: top;"> <p>Mark for explanation (1 mark)</p> <p>1 mark for explanation: The lattice enthalpy is more negative/exothermic than the (sum of the) enthalpies/energies of hydration.</p> </td> <td style="vertical-align: top;"> <p>Mark for explanation (1 mark)</p> <p>1 mark for explanation: The lattice enthalpy is more negative/exothermic than the (sum of the) enthalpies/energies of hydration.</p> </td> </tr> </table> </div>	<p>Mark for drawing a graph (1 mark)</p> <p>1 mark for drawing a graph with a downward-sloping line.</p> <p>1 mark for drawing a graph with a horizontal line at 25°C, then a downward-sloping line.</p>	<p>Mark for drawing a graph (1 mark)</p> <p>1 mark for drawing a graph with a downward-sloping line.</p> <p>1 mark for drawing a graph with a horizontal line at 25°C, then a downward-sloping line.</p>	<p>Mark for explanation (1 mark)</p> <p>1 mark for explanation: The lattice enthalpy is more negative/exothermic than the (sum of the) enthalpies/energies of hydration.</p>	<p>Mark for explanation (1 mark)</p> <p>1 mark for explanation: The lattice enthalpy is more negative/exothermic than the (sum of the) enthalpies/energies of hydration.</p>	2
<p>Mark for drawing a graph (1 mark)</p> <p>1 mark for drawing a graph with a downward-sloping line.</p> <p>1 mark for drawing a graph with a horizontal line at 25°C, then a downward-sloping line.</p>	<p>Mark for drawing a graph (1 mark)</p> <p>1 mark for drawing a graph with a downward-sloping line.</p> <p>1 mark for drawing a graph with a horizontal line at 25°C, then a downward-sloping line.</p>					
<p>Mark for explanation (1 mark)</p> <p>1 mark for explanation: The lattice enthalpy is more negative/exothermic than the (sum of the) enthalpies/energies of hydration.</p>	<p>Mark for explanation (1 mark)</p> <p>1 mark for explanation: The lattice enthalpy is more negative/exothermic than the (sum of the) enthalpies/energies of hydration.</p>					

Page 3	Mark Scheme	Syllabus	Paper
	GCE A LEVEL – October/November 2013	9701	52
(b) (i)	concentration/concentration change		
(ii)	temperature change/decrease in temperature (allow ecf on (a)(i))		1
(c)	Diagram shows a container labelled with its capacity (between 25 cm ³ and 250 cm ³) and with the thermometer in a solution.		1
	The apparatus is insulated and has a lid.		1
	Thermometer range must include 25 °C and with a precision of between 0.1 °C and 0.5 °C.		1
(d)	A minimum of 5 workable experiments using masses or concentrations.		1
	Measures initial and final temperatures.		1
	Measures a volume of water AND the volume of water will fit into container labelled in (c).		1
	States a mass which is the maximum for a volume of water stated.		1
(e)	Ammonium nitrate may cause a fire/explosion so must not be ground up OR dilute to less than 0.5 mol dm ⁻³ before disposal.		1
(f)	Columns must include units: Mass of ammonium nitrate used / any mass unit Volume / mass of water used / any volume or mass units Initial temperature / °C Final temperature / °C Temperature fall / change in temperature / °C Concentration of ammonium nitrate / any concentration units		
	Four columns correct		1
	Five or six columns correct		1
			[Total: 15]

Page 4	Mark Scheme	Syllabus	Paper
	GCE A LEVEL – October/November 2013	9701	52

2 (a)	<table border="1"> <thead> <tr> <th>F</th> <th>G</th> <th>H solubility</th> </tr> <tr> <th>D–C / g</th> <th>C–B / g</th> <th>$[(F \times 100)] / G / g / 100 g$</th> </tr> </thead> <tbody> <tr><td>1.25</td><td>25.00</td><td>5.00</td></tr> <tr><td>1.25</td><td>20.00</td><td>6.25</td></tr> <tr><td>5.00</td><td>25.00</td><td>20.00</td></tr> <tr><td>7.76</td><td>19.40</td><td>40.00</td></tr> <tr><td>11.11</td><td>23.00</td><td>48.30</td></tr> <tr><td>11.75</td><td>25.00</td><td>47.00</td></tr> <tr><td>9.62</td><td>21.00</td><td>45.81</td></tr> <tr><td>9.10</td><td>20.00</td><td>45.50</td></tr> <tr><td>11.25</td><td>25.00</td><td>45.00</td></tr> <tr><td>13.35</td><td>30.00</td><td>44.50</td></tr> </tbody> </table>	F	G	H solubility	D–C / g	C–B / g	$[(F \times 100)] / G / g / 100 g$	1.25	25.00	5.00	1.25	20.00	6.25	5.00	25.00	20.00	7.76	19.40	40.00	11.11	23.00	48.30	11.75	25.00	47.00	9.62	21.00	45.81	9.10	20.00	45.50	11.25	25.00	45.00	13.35	30.00	44.50	
	F	G	H solubility																																			
	D–C / g	C–B / g	$[(F \times 100)] / G / g / 100 g$																																			
	1.25	25.00	5.00																																			
	1.25	20.00	6.25																																			
	5.00	25.00	20.00																																			
	7.76	19.40	40.00																																			
	11.11	23.00	48.30																																			
	11.75	25.00	47.00																																			
	9.62	21.00	45.81																																			
	9.10	20.00	45.50																																			
11.25	25.00	45.00																																				
13.35	30.00	44.50																																				
Heading for final column calculating the solubility is given correctly with units.	1																																					
All data is to 2 decimal places. Allow 1 error.	1																																					
Data in final column is correct. Allow 1 error in computation.	1																																					
(b)	<p>The x-axis must start at zero and be labelled 'temperature / °C' OR T / °C and y-axis as 'solubility (of sodium sulfate) g/100g'. Plotted points must cover at least half the grid in both directions.</p> <p>All 10 points plotted correctly.</p> <p>First (left-hand) curve is smooth passing through (or extremely close to) all the points and does not deviate to accommodate a mis-plot or incorrect point. Curve intersects with a second curve at or above the candidate's solubility for experiment 5.</p> <p>Second curve (right hand) is smooth passing through (or extremely close to) all the points and does not deviate to accommodate a mis-plot or incorrect point.</p>	<p>1</p> <p>1</p> <p>1</p> <p>1</p>																																				
(c)	<p>the temperature is read correctly</p> <p>the solubility is read correctly</p>	<p>1</p> <p>1</p>																																				
(d) (i)	Cross is on the 40 g / 100g line and to the right of the point plotted at 30 °C.	1																																				
(ii)	Transition temperature would be higher as intersection of curves would be at a higher temperature.	1																																				
(e)	<p>Solubility is 47.6 (g / 100g)</p> <p>1.2% OR 1.21% OR 1.28% OR 1.3%</p>	<p>1</p> <p>1</p>																																				

Page 5	Mark Scheme	Syllabus	Paper
	GCE A LEVEL – October/November 2013	9701	52

(f)	<p>Na₂SO₄.10H₂O endothermic because solubility increases with increasing temperature (or reverse argument)</p> <p>Na₂SO₄ exothermic because solubility decreases with increasing temperature (or reverse argument)</p> <p>For endothermic and exothermic correctly assigned For providing the correct reasons</p>	<p>1 1</p>
		[Total: 15]