

CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Level

MARK SCHEME for the October/November 2013 series

9701 CHEMISTRY

9701/51

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

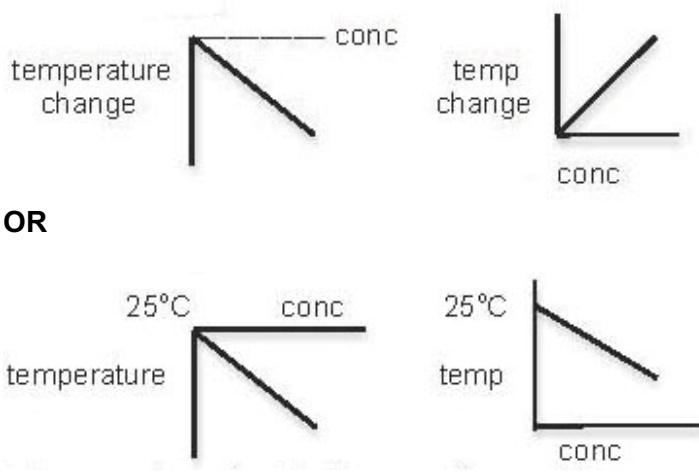
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	GCE A LEVEL – October/November 2013	9701	51

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)	 OR OR ecf from 1(a)(i) 	2

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(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
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2	(a)	<table><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 × 100)] / G / g/ 100 g</th></tr><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></table>	F	G	H solubility	D–C / g	C–B / g	[(F × 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	
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(b)	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.	1																																					
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	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.	1																																					
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(ii)	Transition temperature would be higher as intersection of curves would be at a higher temperature.	1																																					
(e)	Solubility is 47.6 (g / 100g) 1.2% OR 1.21% OR 1.28% OR 1.3%	1 1																																					

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(f)	$\text{Na}_2\text{SO}_4 \cdot 10\text{H}_2\text{O}$ endothermic because solubility increases with increasing temperature (or reverse argument) Na_2SO_4 exothermic because solubility decreases with increasing temperature (or reverse argument)	
	For endothermic and exothermic correctly assigned For providing the correct reasons	1 1
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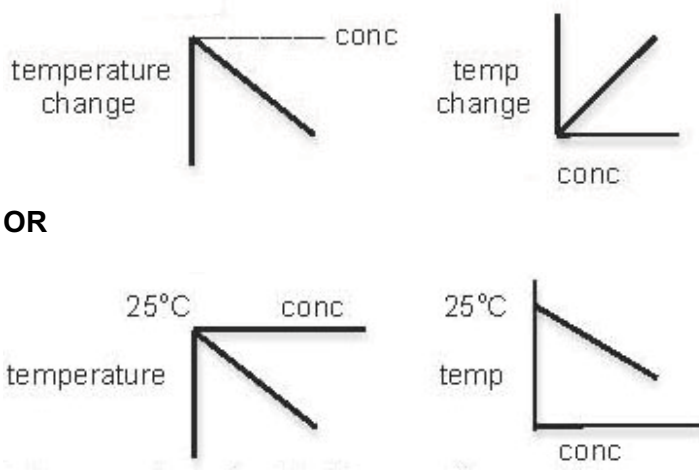
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(c)	Diagram shows a container labelled with its capacity (between 25 cm ³ and 250 cm ³) and with the thermometer in a solution.	1
	The apparatus is insulated and has a lid.	1
	Thermometer range must include 25 °C and with a precision of between 0.1 °C and 0.5 °C.	1
(d)	A minimum of 5 workable experiments using masses or concentrations.	1
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1 (a) (i)	(The solubility of air) decreases (as the temperature is increased).	1
	Dissolving is exothermic so an increase in temperature will promote the reverse reaction (or backwards or right to left).	1
(ii)	Axes are labelled AND graph is a curve/straight line showing a decrease in solubility with temperature.	1
	Graph is scaled and starts at 0 °C on the solubility axis AND goes through point (25 °C, 19 cm ³ dm ⁻³), AND ends at point (100 °C, 0 cm ³ dm ⁻³) AND provided there is no maximum or minimum in the curve. Units required for this mark.	1
(b)	(i) temperature	1
	(ii) solubility (of air).	
	Total 5	
2 (a)	Diagram shows a container with both chemicals named and attached to a syringe connected without leaks.	1
	Container shows the catalyst and hydrogen peroxide separated ready to mix.	1
	100 cm ³ of oxygen is 100/24000 = 0.00417 (mol) (0.004166666)	1
	Mol of H ₂ O ₂ is 2 × mole answer above = 0.00834 (0.00833333) (ecf on alternative volume of oxygen used)	1
	Volume of hydrogen peroxide is therefore (answer above × 1000)/0.30 (27.8 cm ³) (27.78 cm ³) (27.7777773 cm ³) Allow 28 cm ³ (units are required) (reverse calculation also accepted)	1
	The reaction is timed from the moment of mixing to the collection of a stated volume of oxygen.	1
(b)	surface area of catalyst.	1
(c)	Axes are labelled (vol and time or min or s etc.) AND graph is a curve starting at the origin, shows the steepest slope at the start and slowing down as reaction proceeds	1
	x-axis has numerical scale from the origin to at least 3 min and graph shows no change in volume of oxygen after 2 minutes. The time axis must be scaled and have a unit of min or s.	1

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(d)	lead(IV) oxide causes (skin) irritation AND wear (safety) gloves OR Either catalyst or both catalysts (or names or powders or solids) are poisonous AND wear a face mask OR do in a fume cupboard.	1
	Total 10	
3 (a)	$M_r(\text{CCl}_4) = 154$ AND $M_r(\text{C}_2\text{H}_2\text{Cl}_4) = 168$	1
(b) (i)	Mol of $\text{CCl}_4 = 0.0469$ AND mol of $\text{C}_2\text{H}_2\text{Cl}_4 = 0.0531$ AND mole fraction = $0.0469 / (0.0469 + 0.0531) = 0.469$	1
(ii)	Mol of $\text{CCl}_4 = 0.0918$ AND mol of $\text{C}_2\text{H}_2\text{Cl}_4 = 0.00821$ AND mole fraction = $0.0918 / (0.0918 + 0.00821) = 0.918$	1
(c)	The x-axis must start at zero and be labelled as 'mole fraction' with no units and y-axis as temperature or $T/^\circ\text{C}$. Plotted points must cover at least half the grid in both directions. All 16 points plotted correctly . The vapour line is a continuous curve of best fit that does not deviate to accommodate an off curve point. The liquid line is a continuous curve of best fit that does not deviate to accommodate an off curve point.	1 1 1
(d)	Anomalous point is circled at $T = 99.3^\circ\text{C}$ (for the vapour curve). Analysis was made at a temperature that was too low.	1 1
(e)	Horizontal line drawn from 0.500 on the liquid mol fraction curve to meet vapour curve. Correctly reads the value from the vapour curve.	1 1
(f)	For $\text{C}_2\text{H}_2\text{Cl}_4$ $(0.5/120) \times 100 = 0.417\%$ OR $(1.0/120) \times 100 = 0.833\%$ For CCl_4 $(0.5/76) \times 100 = 0.658\%$ OR $(1.0/76) \times 100 = 1.316\%$	1 1
(g) (i)	CCl_4	1
(ii)	Vapour produced when a mixture is heated has a greater proportion of CCl_4 than the mixture/liquid.	1
	Total 15	