**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

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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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.

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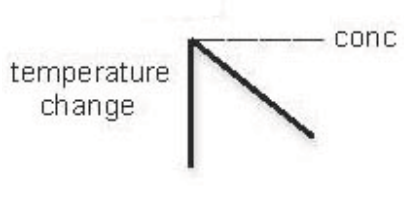
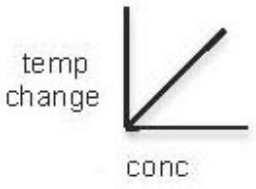
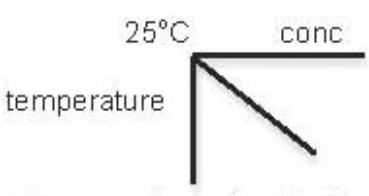
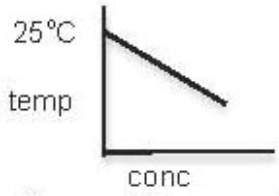
| Question | Expected Answer | Mark |
|---|---|---|
| 1 (a) (i) | (The temperature would) decrease<br><br>The lattice enthalpy is more negative/exothermic than the (sum of the) enthalpies/energies of hydration. | 1<br><br>1 |
| (ii) | <br><br>**OR**<br><br><br>**OR ecf** from **1(a)(i)**<br> | 2 |

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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:<br>Mass of ammonium nitrate used / any mass unit<br>Volume / mass of water used / any volume or mass units<br>Initial temperature / °C<br>Final temperature / °C<br>Temperature fall / change in temperature / °C<br>Concentration of ammonium nitrate / any concentration units | |
| | Four columns correct<br>Five or six columns correct | **1**<br>**1** |
| | | **[Total: 15]** |

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**2 (a)**

| F<br>D–C / g | G<br>C–B / g | H solubility<br>[(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 |

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)**

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**

All 10 points plotted correctly. **1**

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**

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. **1**

**(c)**

the temperature is read correctly **1**
the solubility is read correctly **1**

**(d) (i)**

Cross is on the 40 g / 100 g 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)**

Solubility is 47.6 (g / 100g) **1**

1.2% **OR** 1.21% **OR** 1.28% **OR** 1.3% **1**

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| | | |
|---|---|---|
| **(f)** | $Na_2SO_4.10H_2O$<br>endothermic because solubility increases with increasing temperature (or reverse argument)<br>$Na_2SO_4$<br>exothermic because solubility decreases with increasing temperature (or reverse argument)<br><br>For endothermic and exothermic correctly assigned<br>For providing the correct reasons | <br><br><br><br><br><br>**1**<br>**1** |
| | | **[Total: 15]** |

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