

MARK SCHEME for the October/November 2012 series

9701 CHEMISTRY

9701/53

Paper 5 (Planning, Analysis and 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.

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| Question | Sections | Expected Answer | Mark |
|-------------|--------------|---|------------|
| 1(a) | PLAN Problem | (i) Pressure increases AND <u>frequency</u> of the collisions increases. | [1] |
| | | (ii) Axes labelled AND graph shows a decrease of volume with increased pressure. | [1] |
| | | (iii) Draws (approx) parallel line or curve above the original line. (At least one of the lines must be unambiguously labelled to identify it.) | [1] |
| (b) | PLAN Problem | (i) volume | [1] |
| | | (ii) pressure | [1] |
| | | | [5] |
| 2(a) | PLAN Method | Diagram shows a heated piece of apparatus containing some solid CuCO_3 alone AND apparatus is air-tight (not lids). | [1] |
| | | Shows how the gas is collected by syringe OR over water/other liquid. | [1] |
| | | (Apparatus is labelled and) the size or capacity of the vessel used to collect the gas produced is shown. (Volume of vessel must be greater or equal to 10 cm^3 , maximum 1000 cm^3 .) | [1] |
| (b) | PLAN Method | (i) 30 dm^3 | [1] |
| | | (ii) 24 dm^3 | [1] |
| | | (iii) Calculates the mass of copper carbonate which produces a volume of gas which will fit in the collecting vessel, unit essential. Calculation must be shown and give a mass that would fit in the collecting vessel if decomposition was as given by either equation (2.1 or 2.2, need not be stated). See appendix to mark scheme. | [1] |
| | | (iv) (Reheats) copper carbonate to constant volume of gas. | [1] |
| | | (v) Relates volume of gas collected to the two equations. | [1] |
| (c) | Plan Method | Harmful by inhalation/injection OR hot reaction vessel (not hot Bunsens). | [1] |
| | | Dispose of CuCO_3 by reacting with ethanoic acid | [1] |

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| | | | |
|--------------|--------------|---|-------------|
| | Total | | [10] |
| 3 (a) | ACE Data | <p>One mark for each correctly completed column given to 3 dp excluding the 'mass of water' column. Use table below.</p> <p>If 2 dp used allow 2 marks for 4 columns correct or 1 mark for 2 columns correct. If no columns are completely correct allow 1 mark if at least six values are correct.</p> | [4] |

| percentage by mass of sulphuric acid | mass of sulphuric acid /g | mass of water /g | volume of sulphuric acid /cm ³ | volume of water /cm ³ | total volume of 100 g of solution /cm ³ | calculated density of the solution /g cm ³ | measured density of the solution /g cm ³ |
|--------------------------------------|---------------------------|------------------|---|----------------------------------|--|---|---|
| 0 | 0.000 | 100.000 | 0.000 | 100.301 | 100.301 | 0.997 | 0.997 |
| 10 | 10.000 | 90.000 | 5.476 | 90.271 | 95.747 | 1.044 | 1.064 |
| 20 | 20.000 | 80.000 | 10.953 | 80.241 | 91.194 | 1.097 | 1.137 |
| 30 | 30.000 | 70.000 | 16.429 | 70.211 | 86.640 | 1.154 | 1.215 |
| 40 | 40.000 | 60.000 | 21.906 | 60.181* | 82.087 | 1.218 | 1.299 |
| 50 | 50.000 | 50.000 | 27.382 | 50.150* | 77.532 | 1.290* | 1.391 |
| 60 | 60.000 | 40.000 | 32.859 | 40.120 | 72.979 | 1.370 | 1.494 |
| 70 | 70.000 | 30.000 | 38.335 | 30.090 | 68.425 | 1.461* | 1.606 |
| 80 | 80.000 | 20.000 | 43.812 | 20.060 | 63.872 | 1.566 | 1.722 |
| 90 | 90.000 | 10.000 | 49.288 | 10.030 | 59.318* | 1.686 | 1.809 |
| 100 | 100.000 | 0.000 | 54.765 | 0.000 | 54.765 | 1.826 | 1.826 |

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| | | | |
|-----|-----------------|---|------|
| (b) | ACE Data | y-axis labelled as 'density /g cm ⁻³ ' and x-axis as '% by mass' of sulfuric acid AND all the plotted points cover at least half the grid in both directions. | [1] |
| | | All 20 points present and correctly plotted. | [1] |
| | | Two labelled continuous curves of best fit that do not deviate to accommodate a misplot or incorrect point. Do not allow points connected by straight lines. | [1] |
| | | Both lines are smooth. | [1] |
| (c) | ACE | (i) Difference is 0.09, unit necessary AND higher density is the measured density. | [1] |
| | Evaluation | (ii) Both liquids have hydrogen bonding. | [1] |
| | ACE Conclusions | Explains difference as change/formation in hydrogen bonding between water and sulfuric acid in the mixture OR the ionisation of sulfuric acid in the mixture. | [1] |
| (d) | ACE Conclusions | Gives equation: | |
| | | $\frac{40.000 + M}{60.000} = \frac{70.000}{30.000}$ decimal places not required | |
| | | where M is mass of water required. | [1] |
| | | 100.000 g of water must be added. | [1] |
| (e) | ACE Evaluations | Allow inverse of equation or correct use of V. | |
| | | Mass error either 0.01% OR 0.02%. | |
| | | 0.228% or 0.456% | [1] |
| | Total | If no % given a percentage calculation must be seen. | [1] |
| | | | [15] |

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Appendix

Guide for 2(b)(iii) and 2(b)(v)

| Volume of gas collected /cm³ | Mass according to equation 2.1 /g | Mass according to equation 2.2 /g |
|--|--|--|
| 10 | 0.0412 | 0.0515 |
| 20 | 0.0823 | 0.103 |
| 30 | 0.124 | 0.154 |
| 40 | 0.165 | 0.206 |
| 50 | 0.206 | 0.257 |
| 60 | 0.247 | 0.309 |
| 70 | 0.288 | 0.360 |
| 80 | 0.329 | 0.412 |
| 90 | 0.370 | 0.463 |
| 100 | 0.412 | 0.515 |
| 250 | 1.029 | 1.286 |

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Graphs for 3(b)

