CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Level

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.

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Question	Sections	Expected Answer	Mark
1(a)	PLAN Problem	**(i)** Pressure increases **AND** frequency 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 **(ii)** pressure	[1] [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.	
(c)	Plan Method	Harmful by inhalation/injestion 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	One mark for each correctly completed column given to 3 dp excluding the 'mass of water' column. Use table below. 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.	[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. All 20 points present and correctly plotted. Two labelled continous curves of best fit that do not deviate to accommodate a misplot or incorrect point. **Do not allow** points connected by straight lines. Both lines are smooth.	[1] [1] [1] [1]
(c)	ACE Evaluation ACE Conclusions	**(i)** Difference is 0.09, unit necessary **AND** higher density is the measured density. **(ii)** Both liquids have hydrogen bonding. 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] [1] [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. 100.000 g of water must be added. Allow inverse of equation or correct use of V.	[1] [1]
(e)	ACE Evaluations	Mass error either 0.01% **OR** 0.02%. 0.228% or 0.456% If no % given a percentage calculation must be seen.	[1] [1]
	Total		**[15]**

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Appendix

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

Volume of gas collected /cm^3	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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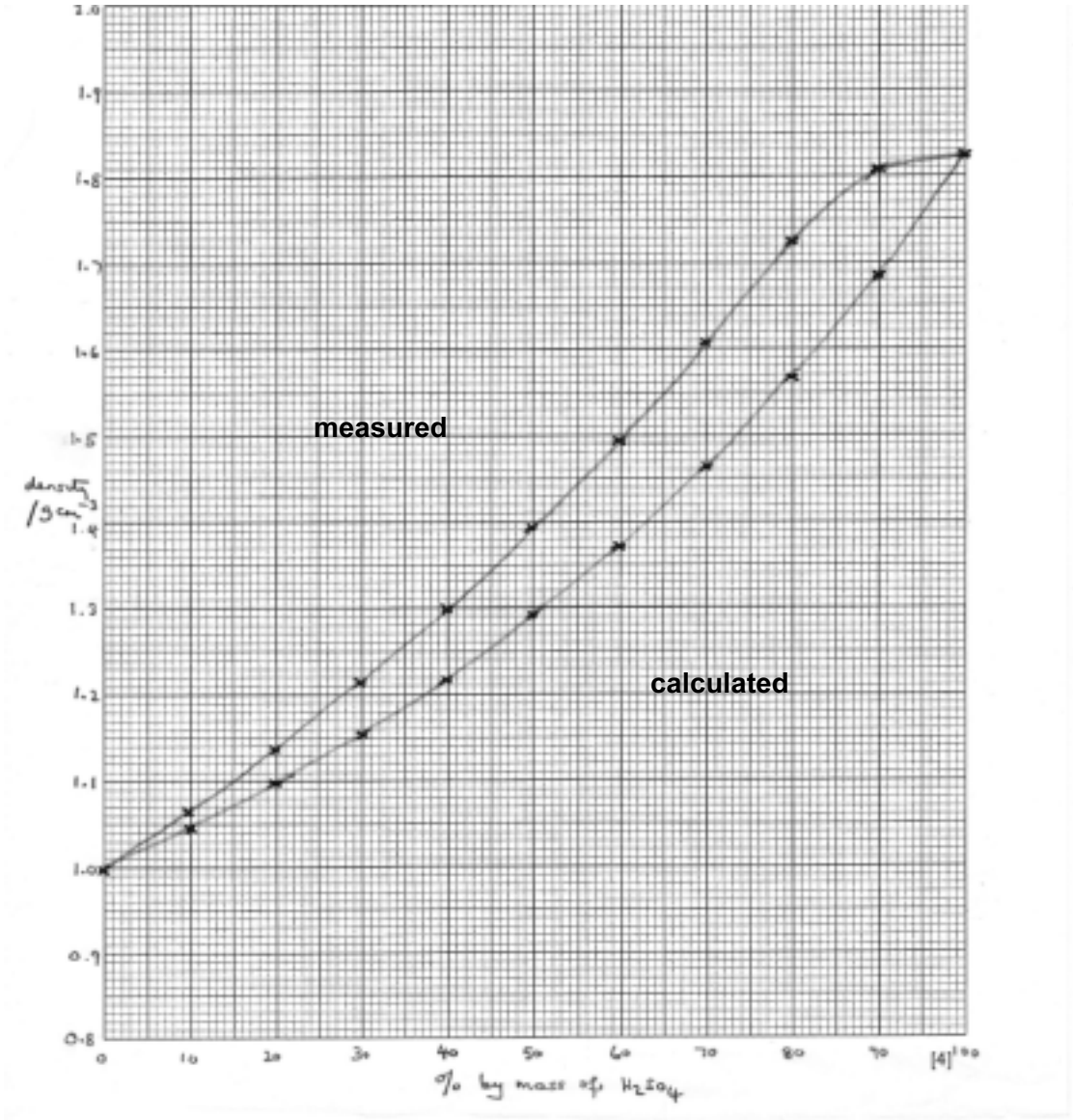
Graphs for 3(b)



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