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.

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 (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 <u>dm³</u>	[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] [1]
		(iv) (Reheats) copper carbonate to constant volume of gas.	
		(v) Relates volume of gas collected to the two equations.	[1]
(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			give colu Use If 2 or 1 com	en to 3 dp eximn. table below dp used allo mark for 2	ccluding the v. ow 2 marks columns co ect allow 1	y completed 'mass of wa for 4 column rrect. If no co mark if at lea	s correct	[4]
percentage by mass o sulphuric acid	of	mass of sulphuric acid /g	mass wate	er	volume of sulphuric acid /cm³	volume of water /cm³	total volume of 100 g of solution /cm³	calculated density of the solution /g cm ³	measured density of the solution /g cm ³
0		0.000	100.0	000	0.000	100.301	100.301	0.997	0.997
10		10.000	90.00	00	5.476	90.271	95.747	1.044	1.064
20		20.000	80.08	00	10.953	80.241	91.194	1.097	1.137
30		30.000	70.0	00	16.429	70.211	86.640	1.154	1.215
40		40.000	60.0	00	21.906	60.181*	82.087	1.218	1.299
50		50.000	50.00	00	27.382	50.150*	77.532	1.290*	1.391
60		60.000	40.0	00	32.859	40.120	72.979	1.370	1.494
70		70.000	30.0	00	38.335	30.090	68.425	1.461*	1.606
80		80.000	20.0	00	43.812	20.060	63.872	1.566	1.722
90		90.000	10.0	00	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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	Total		[15]
		If no % given a percentage calculation must be seen.	[1]
(e)	ACE Evaluations	Mass error either 0.01% OR 0.02%. 0.228% or 0.456%	[1]
		Allow inverse of equation or correct use of V.	
		100.000 g of water must be added.	[1]
		where M is mass of water required.	[1]
		$\frac{40.000 + M}{60.000} = \frac{70.000}{30.000}$ decimal places not required	
(d)	ACE Conclusions	Gives equation:	
	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]
	Evaluation	(ii) Both liquids have hydrogen bonding.	[1]
(c)	ACE	(i) Difference is 0.09, unit necessary AND higher density is the measured density.	[1]
		Both lines are smooth.	[1]
		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.	[1]
		All 20 points present and correctly plotted.	[1]
(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]

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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)

