UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Subsidiary Level and GCE Advanced Level

MARK SCHEME for the October/November 2011 question paper for the guidance of teachers

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 must be read in conjunction with the question papers and the report on the examination.

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International Examinations

Question	Sections	Indicative material	Mark
1 (a)	PLAN Problem	Predicts that the rate of effusion decreases as the M_r increases. If candidates gave 'increasing' then ecf into sketch. **(i)** Correctly labelled axes with rate of effusion on the *y*-axis and M_r on the *x*-axis. **(ii)** Any graph showing a decreasing rate of effusion with increasing M_r (curve or straight line). This curve should not start vertical or show a positive gradient at any stage. It should not touch either axis.	[1] [1] [1]
(b)	PLAN Problem	**(i)** M_r as the independent variable. **(ii)** Rate of effusion/time as the dependent variable.	[1] [1]
(c)	PLAN Methods	**(i)** Flush out the syringe with the gas under test at least once before filling. Accept gas removal by vacuum pump. **(ii)** Starts the descent of the piston above the start volume to ensure constant speed. (Free movement, not pushed to start mark.) **(iii)** Uses the same volume for all the gasses or measures the time between the same two volume marks. Alternatively, candidates may record volume effused over a fixed time for all gases. Table in **1(e)** will change slightly in this case. **(iv)** Constant/same temperature for all experiments. **(v)** Ensures that the syringe is vertical or at the same angle throughout. **(vi)** Repeats the procedure (to obtain means). These may be referred to in the table in **1(e)**.	[1] [1] [1] [1] [1] [1]
(d)	PLAN Methods	Reference to flammability of hydrogen/butane or the poisonous nature of chlorine. Accept explosive nature of hydrogen or butane. Must name the gas. Keep away from flames/use a fume cupboard or gas mask (not just mask). This mark is conditional on naming a gas correctly above. If a candidate only suggests that <u>some</u> gases are poisonous and then suggests a fume cupboard is necessary do not give any marks. If, for example, a candidate suggests that hydrogen, oxygen and butane are flammable, do not award the first mark but reference to no naked flames etc would be worth the second mark. Mark similarly if candidate suggests chlorine and carbon dioxide or butane are poisonous.	[1] [1]

(e)	PLAN Methods	Name /formulae of all the gases; correct M_rs; effusion time (or effusion volume for alternative method); rate of effusion; with relevant units. If an incorrect formula is given, ecf for M_r. All five correct 2 marks; One/two errors, three or four correct 1 mark; More than two errors zero mark.	[2]
	Total		**[15]**

Question	Sections	Indicative material	Mark
2 (a)	ACE Data	Moles of oxygen; e.g. D/16 ; no units. Moles of lead; e.g. E/207; no units. There must be full columns of data with these two headings. Do not accept any incorrect units in these headings. Can accept A_r oxygen etc., not M_r, instead of numerical values. Correct data for moles of lead and oxygen (allow 2 errors). Ecf if 32 used for M_r oxygen. A salvage mark can be awarded for one completely correct mass column, i.e. heading, expression, units and data.	[1] [1] [1]
(b)	ACE Data	Unambiguously labelled axes/Appropriate scaling. Moles of lead or moles of oxygen can be on either axis. Correctly plotted points. All 10 points need to be plotted. Line of best fit which should be drawn to the origin. Lines should be straight with no kinks. If 'non-plots' are given, e.g. moles lead oxide vs moles lead, plotting marks are still available. Candidates cannot access marks in **2(c)** or **2(d)** but can access marks in **2(e)**.	[1] [1] [1]
(c)	ACE Evaluation	Anomalies identified. Allow candidates to select up to 5 anomalous points which must include that furthest from the line. Correct explanation for the first anomaly. Correct explanation for the second anomaly. Point 4, incomplete reduction (to lead side of line). Point 8, material carried away by stream of hydrogen (to oxygen side of line). If two correct explanations are given but not allocated to specific points, give 1 mark.	[1] [1] [1]

(d)	ACE Evaluation	Either no repeats/most points not on the line hence unreliable. Most points on or close to the line hence reliable, not just a straight line is produced.	[1]
(e)	ACE Data	Construction lines present. Takes intercept readings from the graph. Calculates the slope correctly using intercept readings. Gradient can be either $(y_1 - y_2)/(x_1 - x_2)$ or $(y_2 - y_1)/(x_2 - x_1)$.	[1] [1]
(f)	ACE Conclusions	Line is the ratio of oxygen to lead or vice versa. Calculation to determine the formula, i.e. gives the ratio of atoms commensurate with the answer in **2(e)**. States formula. Pb_3O_4 would usually mean that the last 2 marks are awarded automatically. Ecf an over-approximation of the ratio.	[1] [1] [1]
	Total		**[15]**