CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Subsidiary Level and GCE Advanced Level

MARK SCHEME for the October/November 2012 series

9701 CHEMISTRY

9701/31 Paper 3 (Advanced Practical Skills 1), maximum raw mark 40

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.

Cambridge is publishing the mark schemes for the October/November 2012 series for most IGCSE, GCE Advanced Level and Advanced Subsidiary Level components and some Ordinary Level components.

CAMBRIDGE International Examinations

Question	Sections	Indicative material	Mark	Total
1 (a)	PDO Recording	**I** **All** columns correctly headed and correct units given for all columns except for rate/(1000/time) e.g. /s, (s), time in s, time in seconds.	1	
		II Records **all** times to the nearest second. Allow for only 5 expts carried out.	1	
	MMO Decisions	**III** Additional experiment (experiment 6) uses volume of **FA 1** $\geqslant 3\,cm^3$ of any other, and adds water to make $50\,cm^3$. Other volumes are those specified.	1	
	PDO Display	**IV** Candidate gives **all** values of (1000/time) to 3 sig fig – ignore calculation or rounding errors (minimum of 4 expts carried out).	1	
	ACE Interpretation	**V** **All** values of (1000/time) **correctly** calculated to sig fig shown by candidate (minimum of 4 expts carried out).	1	
	MMO Quality	**VI** and **VII** Experiments 2 and 4: calculate $100(2t_2 - t_4)/t_4 \leqslant 20\%$ for 1 mark; $\leqslant 10\%$ for 2 marks. **VIII** and **IX** Experiments 3 and 5: calculate $100(3t_3 - t_5)/t_5 \leqslant 30\%$ for 1 mark; $\leqslant 10\%$ for 2 marks. **X** and **XI** Experiments 4 and 5: calculate $100(2t_4 - t_5)/t_5 \leqslant 30\%$ for 1 mark; $\leqslant 10\%$ for 2 marks. If the candidate has not completed the 5th experiment, marks **VI** and **VII** are available. Also check Experiments 1 and 2: t_2 should equal to $t_1 \times 5/4$. Use the 10% and 20% boundaries. If only the first three experiments are completed, award Q marks based on Experiments 1 and 2 (as above). (*If 50, 45, 40, 35, marks* **X** *and* **XI** *not available. Use 40 and 20 if there + 'rescue' pair as above.*) The Examiner is to round all reaction times to the nearest second before awarding accuracy marks. (*Volumes* ***FA 1****/expt no as specified in Qn)*	6	[11]

(b)	PDO Layout	**I** Plots rate or (1000/time) on *y*-axis and volume of **FA 1**/**FA 1** cm^3 on *x*- axis. Axes correctly labelled. **II** Uniform scales selected. Each scale starts at zero and highest point plotted on each axis has used more than half of the available grid. **III** and **IV** Examiner to check all plotted points. Points must be correct to ½ small square and in correct small square. Award **III** and **IV** for correct points for all experiments carried out (minimum 5). Award **III** only if one mistake made. (If only four expts carried out then all 4 correct.) **V** Draws a "best-fit" straight line – one that passes close to the majority of points and points are balanced. The line does not have to pass through the origin. (Allow curve if appropriate.)	1 1 2 1	[5]
(c)	ACE Conclusions	Depth (of solution) is greater, ... so time is shorter/less//time is faster//fewer seconds (*time is conditional on depth*) **or** solution/liquid depth unchanged so reaction time unchanged for 1 mark.	1 1	[2]
(d)	ACE Interpretation PDO Display	Give **one mark** for a concentration of 0.021/0.0214/0.02143 mol dm^{-3} for expt 5. Working shown must include correct use of 70.	1 1	[2]

(e)	ACE Interpretation	Two pieces of evidence with no conclusion **or** one piece and conclusion. 2nd piece of evidence **and** conclusion. **Evidence for 'correct'** **(i)** a straight line/(line with) constant gradient **(ii)** straight line passes through origin (if appropriate from results) is 2 pieces of evidence **(iii)** line passes through origin = 1 **if** line drawn is straight **Evidence for 'incorrect'** **(i)** a curve has been drawn/no straight line/not constant gradient **(ii)** straight line does not pass through the origin **(iii)** points too scattered/not on best fit line **(iv)** a curve drawn but expect straight line = 2 *A straight line, not passing through the origin could score both marks depending on explanation given (proportional but not directly proportional).* *If two points are compared they must be on or very close to the graph line.*	1 1	[2]
(f)	ACE Interpretation	Candidate correctly evaluates each % uncertainty.	1	[1]
(g)	ACE Improvement/ s	Constant volume of **FA 1**. Varies volume of **FA 2** and water correspondingly (Volume **FA 2** + H_2O same).	1 1	[2]
		Total	**25**	

FA 3 is $CuCl_2(aq)$; **FA 4** is $AlK(SO_4)_2(aq) + KI(aq)$; **FA 5** is $FeCl_3(aq)$; **FA 6** is $Pb(NO_3)_2(aq)$					
2	**(a)**	MMO Collection	Records a blue / greenish-blue ppt / solid with **FA 3** and Na_2CO_3. Records a brown / rust / orange-brown / red-brown ppt / solid with **FA 5** and Na_2CO_3. Records effervescence with **FA 5** (or **FA 3**). Tests gas evolved with limewater. Allow from effervescence.	1 1 1 1	[4]
	(b)	MMO Collection	Records a white precipitate with silver nitrate solution **and** soluble in aqueous ammonia.	1	[1]
	(c)	MMO Collection	Records yellow-brown / orange-brown / brown / tan colour (solid/solution) (formed on mixing **FA 4** and **FA 3**). Allow dark brown for solution **only**. Allow (qualified) brown solution with white / off-white / grey ppt. Dark / deep blue / blue-black / black / purple colour on adding starch solution	1 1	[2]
	(d)	MMO Collection	Mark the observations in the table horizontally or vertically to maximise marks available to the candidate.	4	[4]

Test	**Observations**			
	FA 3	**FA 4**	**FA 5**	**FA 6**
NaOH(aq)	blue ppt **not** dark/deep blue ppt	white ppt (which dissolves as more added/then dissolves)	red-brown / orange-brown / brown / rust ppt (**not** dark / deep brown)	white ppt
excess NaOH	ppt insoluble (no change no observation provided ppt above)	ppt soluble (if no ppt in 1st box allow no change)	ppt insoluble (no change no observation provided ppt above)	ppt soluble (not no change after 'no ppt')
$NH_3(aq)$	blue ppt **not** dark/deep blue ppt	white ppt	red-brown / orange-brown / brown / rust ppt (**not** dark / deep brown)	white ppt
excess ammonia	(ppt soluble) **deep blue soln**	ppt insoluble (no change no observation provided ppt above)	ppt insoluble (no change no observation provided ppt above)	ppt insoluble (no change no observation provided ppt above)

FA 3 is $CuCl_2(aq)$; **FA 4** is $AlK(SO_4)_2(aq)$ + KI(aq); **FA 5** is $FeCl_3(aq)$; **FA 6** is $Pb(NO_3)_2(aq)$					
(e)	ACE Conclusions	Con2 Con2	Give **one mark** for **FA 3** Cu^{2+}/copper/copper(II) **and FA 5** Fe^{3+}/iron(III). Give **one mark** for **FA 4 and FA 6** Al^{3+}/aluminium, Pb^{2+}/lead *Allow* **FA 4** $Al^{3+}(Pb^{2+})$ **and FA 6** Al^{3+}, Pb^{2+} (*There must be some correct evidence for* Cu^{2+} *and* Fe^{3+} *in* **(d)** *but does not have to be fully correct.*)	1 1	[2]
(f)	MMO Decisions	De7	Selects appropriate reagent to distinguish between Al^{3+} and Pb^{2+} e.g. KI, K_2CrO_4, H_2SO_4, HCl (***not*** $BaCl_2$).	1	[1]
(g)	ACE Conclusions	Con2	**No error carried forward in this section.** Award the mark for: **FA 3** chloride **FA 4** iodide **FA 5** insufficient tests	1	[1]
			Total	**15**	