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

9701/35 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.

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Question	Sections	Indicative material	Mark	
1 (a)	PDO Layout Recording	**I** Pairs of thermometer readings and time unambiguously recorded. *Minimum of three pairs.*	1	
		II Correct headings and units. *Units must have solidus: /s; brackets: (s); or describe in words: time in seconds or time in s, solidus/°C; or brackets (°C); or describe in words: temperature in °C. No repeats of unit in table to individual readings.*	1	
		III Time recorded to 1 second and temperature to 0.5°C. (Must have at least one at 0.5°C.)	1	
	MMO Decisions	**IV** Five (minimum) different experiments carried out.	1	
		V Initial temperatures span the range specified in the question. At least 1 at or below 40°C, at least 1 above 50°C and no two within 3°C (minimum 3 readings). If more than 5 readings can be within 3°C.	1	[5]
(b)	ACE Interpretation	**I** Correct means and rates for highest 2 temperatures and lowest 2 temperatures. *Use candidate's times (not corrected).*	1	
	PDO Display MMO Quality	**II** 1000/time recorded 3–4sf.	1	
	Calculate log rate for chosen temperatures. Calculate $\frac{\log \text{rate } 2 - \log \text{rate } 3}{T2 - T3}$ to 3 significant figures (factor A). Calculate (T1 – T2) × factor A and add this to log rate 2. Compare this value with candidate's log rate for T1 and calculate δ.			
		If δ > 0.05 but < or = 0.10 award **III**,	1	
		If δ < or = 0.05 award **III** and **IV**.	1	
		Repeat for (T3 – T4) × factor A and subtract from log rate T3.		
		If δ > 0.05 but < or = 0.10 award **V**,	1	
		If δ < or = 0.05 award **V** and **VI**.	1	
		If 3 experiments, use slowest 2 for 'standard' and award Q marks for fastest (maximum 2)		[6]

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(c)	PDO Layout	**(i)** **I** All points plotted to use at least 5 large squares on vertical axis and 4 on horizontal axis including position of 20°C.	1	
		II *x*-axis to allow extrapolation to 20°C.	1	
		III An appropriate line of best fit is drawn.	1	
	ACE Interpretation	**(ii)** **IV** Correct value to 0.5°C or 1 dp of 1000/t **from graph** *(ignore units).*	1	[4]
(d)	PDO Display	Uses temperature values **10** apart from graph and quotes rates/chooses rates that are doubled and quotes temperatures.	1	
	ACE Conclusions	Relevant comment on data made. This can come from experimental results.	1	[2]
(e)	ACE Interpretation	**(i)** Fastest reaction/first reaction.	1	
		(ii) Expression for % error ecf from **(i)**.	1	[2]
(f)	ACE Interpretation	Temperature change is not the same for each run of the mixture/**FA 2** not at the same temperature as **FA 1** before mixing/difficulty of gauging same level of colour/cannot start clock and pour solutions at same time/reusing boiling tubes could affect concentration. *Not: human error/heat loss or gain/human reaction time.*	1	[1]
(g)	ACE Improvements	Use of thermostatically controlled water bath/data logger for colour intensity/colorimeter/get help from another student. *Improvement must correspond to error specified. Not: automatic timer.*	1	[1]
(h)	ACE Improvements	Same volume **FA 2**.	1	
		Change volume of **FA 1 and** keep total volume constant by adding water for several volumes of **FA 1**.	1	
		All experiments carried out at the same temperature.	1	[3]
				[Total: 24]

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FA 3 is $BaCl_2$ or $Ba(NO_3)_2$; **FA 4** is H_2SO_4; **FA 5** is $NH_4Cl + Na_2SO_3$					
2	**(a)**	MMO Decisions	**(i)** **I** Selects named reagent involving CrO_4^{2-} or CO_3^{2-} (solution) or magnesium.	1	
		PDO Layout	**(ii)** **II** Tabulates evidence of three tests carried out with no repeat headings (irrespective of reagents).	1	
		MMO Collection	**III** **FA 3** yellow ppt or white ppt or no change.	1	
			IV **FA 4** (yellow solution turns) orange or effervescence or effervescence.	1	
			V **FA 5** yellow solution/no reaction/no reaction.	1	
			*Do not allow NaOH for **I** but allow observations to include T rise for **FA 4**.* *If acid as reagent can score only **II**.* *Acidified potassium dichromate is 1 reagent. Do not credit as reagent but credit all observations **FA 3** yellow ppt, **FA 4** no change, **FA 5** green.*		[5]
	(b)	MMO Collection	**I** **FA 3** + **FA 4** white ppt.	1	
			II **FA 4** + **FA 5** no reaction **or** slow effervescence.	1	
			III **FA 5** + **FA 3** white ppt.	1	
			IV ppt insoluble in HC*l* in **(i)** and soluble in HC*l* in **(iii)**.	1	[4]
	(c)	MMO Collection	Mark vertical columns **FA 3** no ppt/ignore **faint/slight** white ppt. **FA 5** no ppt and **gas/ammonia** turning red litmus blue on warming. **FA 4** no visible reaction. Cross out any identified as acid in **(a) (iii)**.	2	[2]

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(d)	ACE Conclusions	All conclusions must follow observations. For each unknown. One mark for ion and one mark for satisfactory evidence. **FA 3** must be Ba^{2+} or Ca^{2+} to gain credit. **FA 3** if CrO_4^{2-} in **(a) (i)**, Ba^{2+} (1). Evidence: yellow ppt or white ppt with **FA 4**/H_2SO_4 **and** no ppt/(faint) white ppt with NaOH (1) (Must have 2 pieces of evidence.) If CrO_4^{2-} not used in **(a) (i)** Ba^{2+} and/or Ca^{2+} (1). Evidence: faint white/no ppt NaOH **and** white ppt with **FA 4**/sulfuric acid/no NH_3 when heated with NaOH (1). (Must have 2 pieces of evidence.). **FA 5** NH_4^+ (1). Evidence: formation NH_3 in **(c)** (1). SO_3^{2-} (1). Evidence: formation SO_2 in **(a)** or **(b)** (1).	1 1 1 1	[4]
(e)	MMO Decisions	Cream ppt (not off white) with $AgNO_3$ (partially soluble/insoluble in aq NH_3)	1	[1]
				[Total: 16]

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