UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Subsidiary Level and GCE Advanced Level

MARK SCHEME for the May/June 2012 question paper

for the guidance of teachers

9701 CHEMISTRY

9701/31 Paper 31 (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	**I** Constructs a table for results	1
	PDO recording	**II** Appropriate headings and units for data given. Volume / V in cm^3, / cm^3 or (cm^3) Time/t in seconds, /s or (s)	1
	PDO recording	**III** All times recorded to the nearest second.	1
	MMO decision	**IV** 3 additional volumes chosen with intervals not less than 2.00 cm^3 and all volumes of **FA 1** greater or equal to 6.00 cm^3	1
	MMO collection	**V** In all 3 additional experiments water is added to make a total of 20.00 cm^3	1
	MMO quality	Round times to nearest second. **VI** + **VII** Compare time for 20.00 cm^3 of **FA 1** with that of supervisor. **VIII** + **IX** Compare time for 10.00 cm^3 of **FA 1** with that of supervisor. The range for award of 1 or 2 depends on the supervisor value. Supervisor value: < or = 15 δ for 2 is 2 and for 1 is 4 16 to 30 δ for 2 is 3 and for 1 is 6 31 to 45 δ for 2 is 4 and for 1 is 8 46 τo 60 δ for 2 is 5 and for 1 is 10 > 60 δ for 2 is 6 and for 1 is 12	2 2 [9]
(b)	PDO display	**(i)** Working to show ans = 5×10^{-5} mol	1
	ACE interpretation	**(ii)** 0.5 x ans to **(b)(i)** = 2.5×10^{-5} mol	1
	PDO display	**(iii)** Working to show that: $(2.5 \times 10^{-5}) / 0.050 =$ $(5 \times 10^{-4}$ mol $dm^{-3})$	1 [3]
(c)	ACE interpretation	Rate correctly calculated using ans **(b)(iii)** / time (or 4.25×10^{-4}). Min 2 s.f. rounded correctly and minimum 4 results.	1
	PDO recording	Unit for rate given as mol $dm^{-3}s^{-1}$.	1 [2]

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Question	Sections	Indicative material	Mark
(d)	PDO layout	**I** Rate on *y*-axis and volume on *x*-axis. Axes clearly labelled (ignore units)	1
		II Linear scale chosen to use at least half of each axis (need not include 0, 0) If no point at 0, 0 cannot count for > half.	1
		III Plotting of points. Minimum of 3 readings.	1
		IV Draws a line of best fit. Minimum 4 readings including 0, 0 (if plotted).	1 [4]
(e)	ACE conclusion	Rate is proportional to peroxodisulfate **concentration** Rate increases as concentration (volume) increases would score one	2 [2]
(f)	ACE interpretation	**(i)** correctly calculates (0.5 / time from Expt 1) × 100. Minimum of 2 s.f.	1
		(ii) $\frac{\text{ans } \mathbf{(b)(iii)}}{\text{Expt 1 time} + 0.5} \times 10^6$ mol dm^{-3} s^{-1} **or** Rate– (% from **(i)** × rate)	1
		(iii) Any reasonable suggestion e.g. difficult to judge colour change / measurement of volumes / variation in T	1
	ACE improvement	use of colorimeter / burettes for all volumes / (thermostatic) waterbath. Not air conditioning.	1 [4]
(g)	ACE conclusion	**(ii)** Thiosulfate concentration / number moles / volume is doubled (1) Time is longer/ reaction is slower with more thiosulfate (1)	2 [2]
			[Total: 26]

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Question	Sections	Indicative material			Mark
FA 5 = $CuCl_2$; **FA 6** = NaOH; **FA 7** = $Pb(NO_3)_2$; **FA 8** = K_2CrO_4; **FA 9** = $MgSO_4$					
2 (a)	MMO collection	Blue ppt insol in excess (1) Not 'dark blue'	White ppt (1) Ignore 'excess'. White ppt soluble in excess (1)	Yellow / brown / greenish-brown ppt (1) Not 'orange, red, red / brown' Ignore excess. No reaction / yellow solution **and** yellow ppt soluble in excess CONs ppt (1)	[5]
(b)	ACE conclusion	Cu^{2+} in **FA 5** **AND** CrO_4^{2-} in **FA 8**			1
		Pb^{2+} in **FA 7** **AND** OH^- in **FA 6**			1
		Cl^- in **FA 5**			1 [3]
(c)	MMO decision	**I** Add $Pb(NO_3)_2$ or $BaCl_2$ or $Ba(NO_3)_2$			1
	MMO decision	**II** Add HNO_3 or HCl			1
	PDO recording	**III** Presents observations in a single table – no extra reagents. Must be > 2 'boxes'			1
	MMO collection	**IV** White ppt			1
	MMO collection	**V** No SO_2 evolved or ppt insoluble			1
	ACE conclusion	**VI** sulfate			1 [6]
					[Total: 14]

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