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

9701/31 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 must be read in conjunction with the question papers and the report on the examination.

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UNIVERSITY of CAMBRIDGE
International Examinations

Question	Sections	Indicative material	Mark	
1 (a)	PDO Recording	**I** Thermometer readings for all experiments recorded to 0.0 or 0.5°C. (At least one recorded to 0.5°C.)	1	
	ACE Interpretation	**II** Calculation of all temperature changes correct.	1	
	MMO Quality	Award **III** for a temperature rise followed by constant temperature (within 0.5°C).	1	
		Award **IV** and **V** for a **maximum** rise within 0.5°C of supervisor.	1	
		Award **IV** for a **maximum** rise within 1.0°C of supervisor.	1	
		Award **VI** and **VII** for the experiment **3** temperature rise within 0.5°C of supervisor.	1	
		Award **VI** for the experiment **3** temperature rise within 1.0°C of supervisor.	1	[7]
(b)	PDO Layout	**I** Axes correct and labelled: temperature change/ T change/ΔT and volume/vol/V (of) sodium hydroxide/NaOH/**FA 1** **and** correct units /°C or (°C) or 'in °C'; /cm^3 or (cm^3) (allow NaOH in cm^3)	1	
		II Scales chosen so that graph occupies at least half the available length for *x*- and *y*-axes.	1	
		III Plotting – all points accurate to within half a small square and in the correct square.	1	
		IV Draws two straight lines of best fit which intersect.	1	[4]
(c)	ACE Interpretation	Reads to nearest ½ square to 1 or 2 dp volume of **FA 1** and temperature rise from intercept. Do **not** award if ΔT at intercept (or point) **<** max ΔT from table unless candidate has clearly indicated the max ΔT is anomalous.	1	[1]

(d)	ACE Conclusions	**I** The temperature/temperature change increases as **more** reaction/more hydrochloric acid/sodium hydroxide reacts/as more water formed. **II** The temperature/temperature change stays constant/decreases when all acid/limiting reagent has reacted/excess NaOH is added.	1 1	[2]
(e)	ACE Interpretation	**I** Volume used in calculation is 65 cm^3 **II** Heat energy change calculated using candidate's value for ΔT correct to 3 or 4 sf	1 1	[2]
(f)	ACE Interpretation	$\frac{25 \times 2}{1000} = \mathbf{0.05}$	1	[1]
(g)	ACE Interpretation PDO Display	**I** $\frac{\text{Candidate's answer to } \textbf{(e)}}{\text{Candidate's answer to } \textbf{(f)}}$ **II** Correct calculation, conversion J to kJ and negative sign to 3 or 4 sf	1 1	[2]
(h)	ACE Conclusions	So that rise in temperature is proportional to increase in energy produced/change in volume gives different change in temperature for same energy produced/ increase in volume requires increase in energy for same temperature rise.	1	[1]
(i)	PDO Display ACE Interpretation	**I** Number moles NaOH = number moles HC*l* (stated or clearly shown) **II** Calculates or expression for Concentration = $\frac{0.05 \text{ (ecf from } \textbf{(f)})}{\text{answer to } \textbf{(c)}/1000}$ If answer only, award mark if correct to 3 or 4 sf	1 1	[2]
(j)	ACE Improvements	Use more **concentrated** solutions. (allow use **≤ 5** cm^3 water each time) Ignore all references to heat energy losses.	1	[1]
(k)	ACE Conclusions	**I** Two straight intersecting lines (positive followed by zero gradient). **II** Same ΔT and V shown as in **(b)**.	1 1	[2]
				[Total: 25]

FA 3 is $Na_2S_2O_5$(s); **FA 4** is Na_2CO_3(s); **FA 5** is Na_2SO_4(s); **FA 6** is $Pb(NO_3)_2$(s) and (aq)

2	**(a)**	MMO Decisions	**(i)** **I** Any named mineral acid or formula or (acidified) potassium dichromate Do **not** allow any reagent suitable for testing cations or more than one reagent.	1	
		PDO Recording	**(ii)** **II** Tabulates evidence of 3 tests carried out with no repeat headings. **Only** consider observations with acid or dichromate.	1	
		MMO Collection	**III** Bubbles/effervescence in **FA 4**.	1	
			IV Slower effervescence in **FA 3** than **FA 4** or **FA 3** turns green **and FA 5** stays orange if dichromate used.	1	
		MMO Decisions	**V** Appropriate test with positive result used to test for either gas.	1	
		ACE Conclusions	**VI** All three ions correct from suitable observations. **FA3** is a sulfite. **FA4** is a carbonate. **FA5** is a sulfate. (or correct formulae)	1	[6]
	(b)	MMO Collection	**(i)** **I** **FA 4** + **FA 6** white ppt **and** **FA 5** + **FA 6** white ppt.	1	
			II **FA 6** + NaOH white ppt, soluble in excess sodium hydroxide.		
			III Brown gas		
			IV Gas relights glowing splint.		
			V Yellow residue or crackling/decrepitating.		
		ACE Conclusions	**VI** Gas identified as oxygen or as NO_2 from observations.		[6]
		ACE Conclusions	**(ii)** Lead/Pb^{2+} provided correct observations with **FA 6** + NaOH **and** **FA 6** + **FA 5** (sulfate).	1	[1]
		MMO Decisions	**(iii)** **I** Add HCl / H_2SO_4 / KI / K_2CrO_4 / NH_3*	1	
		MMO Collection	**II** white ppt/white ppt/yellow ppt/yellow ppt/white ppt insoluble in excess. * If not Pb^{2+} in **(ii)** but one of Al^{3+}, Ba^{2+}, Ca^{2+}, Zn^{2+} allow suitable reagent mark: K_2CrO_4 for Ba^{2+} and NH_3 for the other three. However, observation must be correct for $\mathbf{Pb^{2+}}$.	1	[2]
					[Total: 15]