UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Subsidiary Level and GCE Advanced Level

MARK SCHEME for the May/June 2011 question paper

for the guidance of teachers

9701 CHEMISTRY

9701/32 Paper 32 (Advanced Practical Skills 2), 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** Volume given for Rough titre **and** accurate titre details tabulated. *Minimum of 2 × 2 boxes.*	1	
	MMO Collection	**II** Initial and final (burette) (readings) and volume of **FB 2** added/reading at start and finish recorded for each accurate titre (not 'difference'). **and** mass tube + **FB 1,** mass tube + residue/empty, mass **FB 1**. Ignore units. *Headings should match readings.* *Do not award this mark if:* *50(.00) is used as an initial burette reading;* *More than one final burette reading is 50(.00);* *Any burette reading is greater than 50(.00).*	1	
	PDO Recording	**III** All accurate burette readings (initial and final) recorded to nearest 0.05 (cm^3). *Assessed on burette readings only (minimum of 2 readings).*	1	
	MMO Decisions	**IV** Has two uncorrected accurate titres within 0.1 cm^3. *Do not award this mark if, having performed two titres within 0.1 cm^3, a further titration is performed that is more than 0.10 cm^3 from the closer of the initial two titres, unless a fourth titre, within 0.1 cm^3 of any of the previous titres, has also been carried out.*	1	
Round any burette readings to the nearest 0.05 cm^3. Check and correct, if necessary, subtractions in the titre table and in the calculation of mass. Examiner then selects the 'best' titre using the hierarchy: two identical; titres within 0.05 cm^3, titres within 0.1 cm^3 etc. Calculate: candidate's titre × $\frac{\text{Supervisor mass}}{\text{candidate mass}}$ to 2 decimal places Calculate difference in Supervisor and candidate scaled values and award quality marks as below.				
	MMO Quality	**V**, **VI** and **VII** Award **V, VI** and **VII** if $\delta \leq 0.25\,cm^3$ Award **V** and **VI** if $0.25 < \delta \leq 0.50\,cm^3$ Award **V** if $0.50 < \delta \leq 0.80\,cm^3$ *If the 'best' titres are ≥ 0.60 cm^3 apart cancel one of the Q marks.*	3	[7]

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(b)	ACE Interpretation	Calculates the mean, correct to 2 decimal places from any **accurate** titres within 0.2 cm^3. *The third decimal place may be rounded to the nearest 0.05 cm^3.* *A mean of exactly .×25 or .×75 is allowed but the candidate may round up to .×3 or .×8 or to the nearest 0.05 cm^3.* *If ALL burette readings are given to 1 decimal place then the mean can be given to 1 decimal place if numerically correct without rounding,* *Mean of 24.3 and 24.4 = 24.35 (✓)* *Mean of 24.3 and 24.4 = 24.4 (×)* **Titres to be used in calculating the mean must be clearly shown – in an expression or ticked in the titration table.** Allow ecf from subtraction error for titre.	1	[1]
(c)	ACE Interpretation	**I** Correctly evaluates step **(i)** (= mean titre × 0.2 / 1000) **II**, **III** and **IV** are awarded for the correct expression or for the correct answer if no working shown. For all 'method' marks, no additional steps can be included. **II** Step **(ii)** (answer to **(i)** / 2) **and** step **(iii)** (answer to **(ii)** × 10) **III** In **(iv)** relative formula mass (= mass of washing soda / answer to **(iii)**) (ignore g) **IV** In **(v)** answer to **(iv)** – 106 / 18 **or** 106 + 18x = answer to **(iv)** (mark method even if M_r is < 106 or very large). **V** Some relevant working shown in a minimum of four parts in the calculation (in **(ii)** could be × 2 or ÷ 2, in **(iii)** could be × 10 or ÷ 10, in **(v)** could be use of 106). **VI** In steps **(i)** to **(iv)** all answers to 3 or 4 sig figs (minimum of 3 steps).	1 1 1 1 1 1	[6]
	PDO Display			
(d)	ACE Interpretation	0.1 × 100 / titre from **(b)** (only expression needed).	1	[1]
				[Total: 15]

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2 (a)	PDO Layout	**I** Two balance readings, one mass, two thermometer readings and one change in temperature shown in suitable layout.	1	
	PDO Recording	**II** Masses and temperatures recorded with correct headings and units for all data shown. *Acceptable units for temperature are / °C, (°C), temperature in degrees Celsius, temperature in °C., units for mass are /g, (g), mass in grams.*	1	
	PDO Recording	**III** All thermometer readings recorded to 0.0 °C or 0.5 °C and all balance readings recorded to same degree of accuracy.	1	
Round all thermometer readings to nearest 0.5 °C.Check and correct, if necessary, subtractions in the temperature change and the mass used. Calculate to 1 decimal place: candidate temperature change × $\frac{\text{Supervisor mass}}{\text{candidate mass used}}$ Calculate difference in candidate and Supervisor scaled values and award quality marks as below.				
	MMO Quality	**IV** and **V** Award **IV** and **V** for changes within 0.8 °C of Supervisor Award **V** for changes > 0.8 but within 1.6 °C of Supervisor	2	[5]
(b) (i)	ACE Interpretation	**I** Expression for heat change in **(i)** = 25 × 4.3 × temperature change from **(a)** (answer given must correspond to units quoted).	1	
(ii)		**II** Expression for moles of washing soda from mass used and M_r from **(a)** or M_r = 259 or Mr = 286 in **(ii)**	1	
(iii)		**III** Correctly evaluates enthalpy change = heat change / (1000 × moles of washing soda) in **(iii)** (if 1000 not used, must say J).	1	
	ACE Conclusions	**IV** Enthalpy change shown as positive and to 3 sig figs. (Answer need not be arithmetically correct). Ignore sig figs (except if approximated to 1 sig fig in rest of question.)	1	[4]
(c)	ACE Improvements	Use a more precise thermometer/a thermometer with more accurate calibrations/a thermometer that reads to 0.1 °C or 0.2 °C (a more accurate thermometer/a digital thermometer/thermocouple is insufficient) **or** use a more precise method to measure the volume of acid **or** use a deeper plastic cup **or** scaling up apparatus and quantities of chemicals used (Do not accept 'add a lid')	1	[1]
				[Total: 10]

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FB 5 is $MgSO_4(aq)$; **FB 6** is $Pb(NO_3)_2(aq)$ **FB 7** is $Al_2(SO_4)_3(aq)$; **FB 8** is $(NH_4)_2FeSO_4(aq)$				
3 (a) (i)	MMO Decisions	**I** Reagents chosen KI(aq) or HCl(aq) or K_2CrO_4 or $K_2Cr_2O_7$ or H_2SO_4 and NaOH (aq) (penalise additional reagents)	1	
	MMO Collection	**II** NaOH white precipitates for all	1	
		III Excess NaOH no effect **FB 5**, precipitate dissolves **FB 6** and **FB 7**	1	
		IV KI / HCl / K_2CrO_4 / $K_2Cr_2O_7$ / H_2SO_4 nothing/no visible reaction for (**FB 5** and **FB 7**), yellow precipitate/white precipitate for **FB 6.**	1	
		Ignore observations for additional reagents.		[4]
(ii)	ACE Conclusions	**I** **FB 5** contains Mg^{2+}, **FB 6** contains Pb^{2+} and **FB 7** contains Al^{3+} (no ecf and must follow observations in **(i)**)	1	
		II **FB 5** (white) precipitate with NaOH, insoluble in excess	1	
		III **FB 6** (yellow) precipitate with KI / (yellow) precipitate with K_2CrO_4 or $K_2Cr_2O_7$ / (white) precipitate with HCl or H_2SO_4.	1	
		FB 7 No precipitate with KI / HCl / H_2SO_4 **and** (white) precipitate with NaOH, soluble in excess. (Both observations needed unless **FB 6** already identified as Pb^{2+}).	1	
		Allow ecf, based on candidate's observations, for **II**, **III** and **IV**.		[4]

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(b) (i)	MMO Collection	Effervescence/bubbles/hydrogen produced (ignore any test for ammonia but tests for other gases negate). (Do not accept gas produced) **or** Black/grey solid/coating on magnesium	1	
(ii)		Ammonia/gas turns litmus paper blue	1	
(iii)		Green precipitate (any qualified green including grey/green but do not allow green/brown.)	1	
		Turns brown (any qualified brown) on addition of hydrogen peroxide. Allow rusty or orange/brown precipitate but not orange alone. Ignore effervescence.	1	
		Fe^{2+} / iron (II).	1	[5]
	ACE Conclusions	(+)2 to 0 (ecf on chromium (+)3 to 0) or (+)3 to (+)2).	1	
		(+)2 to (+)3.	1	
		Conclusions are free standing but must be Fe^{2+}.		[2]
				[Total: 15]

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