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

9701/31 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** Volume given for rough titre **and** accurate titre details tabulated. *Minimum of 2 × 2 boxes.*	1	
	MMO Collection	**II** Initial and final burette readings recorded for rough titre **and** initial and final burette readings and volume of **FA 2** added recorded for each accurate titre. *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.*	1	
		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 which is more than 0.10 cm^3 from the closer of the initial **two** titres, unless a fourth titration, 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 subtractions in the titre table. Examiner then selects the "best" titre using the hierarchy: two identical; titres within 0.05 cm^3; titres within 0.1 cm^3; etc				
	MMO Quality	**V**, **VI** and **VII** Award **V**, **VI** and **VII** for a difference from Supervisor within 0.20 cm^3 Award **V** and **VI** for a difference of > 0.20 – ≤ 0.40 cm^3 Award **V** for a difference of > 0.40 – ≤ 0.60 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 0.20 cm^3. *The third decimal place may be rounded to the nearest 0.05 cm^3.* *A mean of exactly .x25 or .x75 is allowed but the candidate may round up or down 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.***	1	[1]
(c)	ACE Interpretation	**I** Expression needed in step **(i)** (= mean titre $\times 0.15/1000$ mol) **and** step **(ii)** (= answer to step **(i)** / 2) *No irrelevant or incorrect working should be included.*	1	
		II Correctly evaluates step **(iii)** (= answer to step **(ii)** × 10) **and** step **(iv)** (= answer to step **(iii)** × 40)	1	
	PDO Display	**III** Some **relevant working** shown in a minimum of **three** parts in the calculation. (In **(ii)** could be × 2 or ÷ 2, in **(iii)** could × 10 or ÷ 10).	1	
		IV **All** answers given are quoted to 3 or 4 sig figs (must be a **minimum** of three steps)	1	[4]
				[Total: 12]

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2 (a)	MMO Collection	**I** Two pairs of temperature values recorded as instructed in **(a)**, with units for all readings in **(a)** and **(b)** – minimum of 3 readings. *Acceptable units are /ºC, (ºC), temperature in degrees Celsius, temperature in ºC.*	1	
	PDO Recording	**II** **All** thermometer readings recorded to 0.0 ^{o}C or 0.5 ^{o}C. (check readings in sections **2(a)** ***and*** **2(b)** – minimum of 4 readings).	1	
	ACE Interpretation	**III** Correct subtractions to give temperature rises **and** the correct mean value in **2(a)**. *Mean value may be rounded to 0.5 ^{o}C* **or** *to one d.p* **or** *to 0.05 ^{o}C and from 0.025 and 0.075 or these may be rounded up or down to nearest 0.1.*	1	
Supervisor script: check subtractions and calculate mean ΔT *Marks are awarded for comparing the "true" means: check working of candidate and Supervisor.* *Show Supervisor's mean (corrected* ***if*** *necessary) on the script in a ring.*				
	MMO Quality	Award **IV** and **V** if candidate's mean temp rise is within 2.0 ^{o}C of Supervisor's (incl) Award **IV** if the difference is between 2.0 ^{o}C and 3.0 ^{o}C.	1 1	[5]
	PDO Display	Heat produced (J) = 25 × 4.3 × temp rise *(method mark)*. *Unit is needed in the quoted answer (kJ if divided by 1000).* Correctly evaluates enthalpy change = $^{\text{heat produced}}/_{0.016}$. *Division by 1000 is not required if candidate did this in the previous step.* *Answer must be negative and to 3 sig figs.*	1 1	[2]

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Examiner to calculate 20% and 40% of supervisor's ΔT and convert to nearest 0.5°C.				
(b)	ACE Interpretation MMO Quality	**I** Both temperature measurements clearly shown. Award **II** and **III** if candidate's temp rise is within 20% of Supervisor's. Award **II** if candidate's temp rise is within 40% of Supervisor's.	1 1 1	[3]
	ACE Interpretation PDO Display ACE Conclusions	**IV** Calculates 0.032 for moles in **(ii)** or 0.016 for moles in **(a)(ii)**. **V** Enthalpy change correctly calculated (= – $^{\text{heat change}}/_{0.032}$). *Answer **must** show negative sign (unless already penalised) and be given to 3 sig figs. (unless already penalised).* **VI** Correct calculation of enthalpy change $\Delta H_1 = \Delta H_2 - \Delta H_3 - 286$	1 1 1	[3]
(c)	ACE Improvements	Extra/thicker lagging ***or*** use a lid ***or*** use a vacuum flask	1	[1]
				[Total: 14]

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		FA 7 is $Zn(NO_3)_2(s)$; **FA 8** is $CuSO_4(s)$		
3 (a) (i)	MMO Collection	No change (***or*** no precipitate **or** no reaction) both with barium chloride and silver nitrate.	1	
	MMO Collection	**Gentle** heat: solid melts **or** dissolves **or** gives a colourless liquid	1	
(ii)		Brown fumes/gas produced (allow 'qualified' brown e.g. red/brown, do not allow orange).	1	
		(Gas produced) that relights a glowing splint **or** yellow solid, goes white on cooling. (Allow precipitate).	1	
(iii)	ACE Conclusions	**FA 7** is a nitrate/nitrite (from some evidence)	1	
(iv)	MMO Decisions	(Heat) **FA 7** with A*l* foil and NaOH/ecf from anion given.	1	
	MMO Collection	Gas/vapour/NH3 produced ***and*** it turns red litmus to blue ***and*** confirms that **FA 7** contains nitrate/nitrite ions.	1	
(v)	MMO Decisions	Adds ammonia. *(This mark is **not** awarded if a second test is also used)*	1	
	ACE Conclusions	Zinc ions are present. (No ecf) *(Deduction **must** be consistent with observations recorded – white ppt soluble in excess)*.	1	[9]
(b) (i)	MMO Collection	With KI, goes yellow/orange/brown ***and*** gives a blue (blue-black ***or*** purple ***or*** black) colour with starch. *No reference to the state is required, just the colours.*	1	
		Brown/yellow/white/off- white precipitate forms.	1	
(ii)	ACE Conclusions	KI is the reducing agent (**or** it is oxidised) as iodine is formed **or** $2I^- - 2e^- \rightarrow I_2$ **or** $2Cu^{2+} + 2I^- \rightarrow I_2 + 2Cu^+$ *Ignore state symbols.*	1	
(iii)	MMO Collection	Blue (do not allow dark blue) precipitate obtained, which does not dissolve in excess NaOH	1	
	ACE Conclusions	$Cu^{2+} + 2OH^- \rightarrow Cu(OH)_2$	1	[5]
				[Total: 14]

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