UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Subsidiary Level and GCE Advanced Level

MARK SCHEME for the May/June 2009 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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UNIVERSITY of CAMBRIDGE
International Examinations

Question 1

Supervisor's Report

Calculate, correct to 2 d.p., the titre if the Supervisor had diluted 42.75 cm^3 of **FB 2**.

This is given by the expression $\frac{\textbf{42.75}}{\textbf{volume diluted}} \times \textbf{titre}$

Candidate scripts

Calculate the scaled titre for 42.75 cm^3 of **FB 2**.
Record the scaled value against the titration table and calculate the difference to Supervisor.

Question	Sections	Indicative material	Mark	
1 (a)	PDO Layout	**(i)** Tabulates initial and final burette readings and volume added in each of the tables. *Do **not** award this mark if any final and initial burette readings are inverted or 50 is used as the initial burette reading.*	1	
	PDO Recording	**(ii)** Both burette readings in the dilution table and final and initial burette readings for all accurate titres in the titration table recorded to the nearest 0.05 cm^3.	1	
	MMO Collection	**(iii)** Follows instructions: dilutes 42.50 cm^3 to 43.00 cm^3 **and** has any two titres, which may include a rough titre, within 0.20 cm^3	1	
	MMO Decisions	**(iv)** Has at least two titres within 0.1 cm^3. *Do **not** include any titre labelled "rough"/"trial" **unless** the candidate has ticked that value or used it in an expression when calculating the average in **(b)**.*	1	
		(v) and (vi) Accuracy Give **(v) and (vi)** if difference to Supervisor is **0.3** or less Give **(vi) only** for a difference of **0.3+ to 0.5** Give **neither** for a difference greater than **0.5**	2	[6]

(b)	ACE Interpretation	***Working must be shown in this section or the selected titres ticked in the titration table*** Candidate selects/calculates appropriate "average" from any titre values within 0.20 cm^3. *Candidate is permitted to use a titre labelled "rough" or "trial".* Where **all** titres are given to 1 decimal place the average should be calculated correct to 1 or 2 decimal places. Where any titre is recorded to 2 decimal places, the average should be calculated to 2 decimal places or rounded to the nearest 0.05 cm^3.	1	[1]
(c)	ACE Interpretation	**(i), (ii) and (iii)** Check each step of the calculation. Award three marks if all steps are chemically correct, ignore evaluation errors. Withhold 1 mark for each chemical error – no negative marks. (Count non-completed steps as chemical errors.) step 1 $\frac{\textbf{titre}}{\textbf{1000}} \times \textbf{0.023}$ step 2 **5 e^- in 1st eqn; 2 e^- in 2nd eqn** step 3 **× <u>candidate's ratio</u>** from step 2 The expected ratio is $^5/_2$ step 4 **×** $\frac{\textbf{1000}}{\textbf{25}}$ step 5 **×** $\frac{\textbf{250}}{\textbf{volume diluted}}$ [**or** (10 × step 3) **×** $\frac{\textbf{1000}}{\textbf{volume diluted}}$] step 6 **× 126**	3	
	PDO Display	**(iv)** Working shown in at least three of steps 1 & 3–6.	1	
		(v) Answers to 3 or 4 significant figures in final answer to each step attempted from steps 1 & 3–6 **(minimum of three steps required)**.	1	[5]
				[Total: 12]

Question 2 Round all thermometer readings to the nearest 0.5 °C

Supervisor's Report
Calculate ΔT/m correct to 2 d.p. for each experiment.

Candidate's scripts
Calculate ΔT/m correct to 2 d.p. for each experiment.
Record values of ΔT/m on script and use in assessing accuracy marks.
Where a candidate has performed one or both of the experiments a number of times (as distinct from adding in portions and recording the increasing temperature on each addition):
Calculate (unrounded) the ΔT/m value for each experiment, then
Take the average of the closest pair, rounded to 2 d.p.

Question	Sections	Indicative material	Mark	
2 (a)	PDO Layout	Tabulates or lists all experimental readings: • mass of tube + **FB 4** • mass of tube + residue • mass, $\mathbf{m_1}$, of **FB 4** • initial temperature • final temperature • ΔT	1	[1]
(b)	MMO Quality	Calculate the difference between the Supervisor and candidate values of ΔT/m. Give **two marks** for a difference up to 0.1 °C g^{-1} Give **one of these two marks** for a difference of +0.1 °C g^{-1} to 0.3 °C g^{-1}.	2	[2]
(c)		No mark		
(d)	ACE Interpretation	Calculates (0.15 × 84) **or** has 12.6 g $NaHCO_3$	1	[1]
(e)	ACE Interpretation	Gives the maximum error as 1.0 °C. *Do not award this mark for an answer of 1.*	1	[1]
(f)	ACE Interpretation	Calculates $\frac{\textbf{candidates answer to (e)}}{\textbf{1.50}}$ **× 100**% correct to: 2 significant figures (67%) **or** 3 significant figures (66.7%) **or** 4 significant figures (66.67%) Accept $66^2/_3$.	1	[1]
(g)	MMO Decisions	Selects a mass between **8.0 and < mass of $NaHCO_3$** calculated in **(d)**. *(If the candidate's answer to* **(d)** *is < 8.0 g; the mass selected should be in the range:* $^2/_3$ ***× mass in* (d) *and < mass in* (d)**) **and** estimates (mass × 1.5) correctly If no mass has been calculated/given in **(d)**, this mark cannot be awarded.	1	[1]

(h)	PDO recording	Records all weighings, <u>consistently</u>, to at least 1 decimal place in **(a)** and **(h)**. Records all thermometer readings to (.0) or (.5) in **(a) and (h)**. *Where the experiment in **(h)** has not been attempted, only the mark for consistent weighings may be awarded – from the experimental results in **(a)**.*	1 1	[2]
(i)	MMO Collection	**Where mass of (empty) test-tube and mass of test-tube + FB 5 are given:** mass added to the test-tube should be ±0.2 g from mass selected in **(g)**. **If no mass of (empty) test-tube is recorded**, **but mass of test-tube + FB 5 and mass of test-tube + residual FB 5 are recorded:** mass of **FB 5** used in the experiment should be in the range (+0.2 to –0.5)g of mass selected in **(g)**. Calculate the difference between **1.30** and the candidate's value of ΔT/m. Give **two marks** for a difference up to 0.2 °C g^{-1} Give **one of these two marks** for a difference of +0.2 °C g^{-1} to 0.4 °C g^{-1}	1 2	[3]
(k)	ACE Conclusions ACE Interpretation	Manipulates Hess cycle to show that $\Delta H_3 = \Delta H_1 - 2\Delta H_2$ **or** $\Delta H_1 = \Delta H_3 + 2\Delta H_2$ **or** $2\Delta H_2 = \Delta H_1 - \Delta H_3$ Correctly calculates a value for ΔH_3 from equation given by candidate and candidate values from **(c)** and **(j)**. *A +ve sign must be given for any endothermic change* *The candidate must use the exact values given in the final answers to* **(c)** *and* ΔT/m *but may then correctly round their answer to at least 3 significant figures.*	1 1	[2]
(l)	ACE Improvement	Suggests additional insulation (lid etc.) *Candidate must suggest a suitable material to use as insulation or explain how or where the insulation is to be applied.* **or** plots cooling/heating curves, extrapolating to lowest/highest temperature.	1	[1]
				[Total: 15]

Question	Sections	Indicative material	Mark	
FB 6 is NaBr; FB 7 is NaI; FB 8 is $ZnSO_4$(aq), FB 9 is $MgSO_4$(aq)				
3 (a)		No mark		
(b)	**Reagents available:** HC*l*; NaOH(aq); NH_3(aq); BaCl_2/$Ba(NO_3)_2$(aq); $Pb(NO_3)_2$(aq); $AgNO_3$(aq); $K_2Cr_2O_7$(aq); Br_2(aq); concentrated H_2SO_4			
	MMO Decisions	**(i)** Selects $AgNO_3$ as one reagent **and** NH_3(aq) added to the ppt produced with $AgNO_3$ **or** $Pb(NO_3)_2$ / $K_2Cr_2O_7$ added as fresh reagents. *The reagent must be named or the formula of the reagent given.*	1	
	MMO Collection	**(ii)** Correct observations for an appropriate pair of reagents for **FB 6**	1	
		(iii) Correct observations for an appropriate pair of reagents for **FB 7** *Expected observations:*	1	
	ACE Conclusion	**(iv)** Makes appropriate consequential conclusions from observations given (**FB 6** contains Br^- and **FB 7** contains I^- but Cl^- may be given from white ppt with Ag^+. *Allow* Br^- *from off-white ppt insoluble or partially soluble in ammonia.*	1	[4]

	FB 6 *(Br^-)*	**FB 7** *(I^-)*
$AgNO_3$	*cream ppt (off-white ppt is **NOT** acceptable)*	*yellow ppt*
NH_3(aq)	*ppt insoluble or partially soluble*	*ppt insoluble*
$Pb(NO_3)_2$	*white ppt*	*yellow ppt*
$K_2Cr_2O_7$	*no change*	*brown solution*

One of the observation marks can be awarded for correct observations on adding $AgNO_3$ to **FB 6** ***and*** **FB 7** *if this is to the candidate's advantage.*

(c)

Look for the following marking points:

FB 6		FB 7	
(i)	yellow/orange/red solid, solution, liquid or mixture (not colour alone) **or** orange/red/brown gas or vapour	**(i)**	brown/grey/black (not blue-black) solid **or** purple gas/vapour *(gas can be awarded in either of the first two boxes)*
(ii)	white or steamy fumes *(in either of the first two boxes)*	**(ii)**	"bad-egg" smell or (smell of) H_2S **or** test for H_2S (including dichromate turning green)
(iii)	positive test for SO_2	**(iii)**	Orange/dark red/red-brown/ brown solution (no solid) on adding distilled water
(iv)	no change (but not no ppt) with starch	**(iv)**	blue/blue-black/ purple/purple-black/black colour (of solution or solid)

MMO Collection

Give **one mark** for **two** out of four correct marking points for **FB 6** — 1

Give **one mark** for **three** out of four correct marking points for **FB 7** — 1

[2]

(d) MMO Collection

Observes:
yellow/orange/red/brown colour on adding $Br_2(aq)$, providing there is no precipitate or solid
and
blue/blue-black/purple/purple-black/black colour (of solution or solid) — 1

[1]

(e) ACE Conclusions

Conclusions for halide/sulfuric acid reaction

Any reference to Br_2 or I_2 being produced or halide oxidised — 1

Sulfuric acid is an oxidising agent. — 1
H_2SO_4 oxidises halide scores both marks.

Conclusions for bromine water/iodide reaction

Correct description of displacement or redox reaction involving both of the halogens/halides: — 1
e.g. (i) halogen/halide *Bromine oxidises iodide ions.*
(ii) halogen/halogen *Br_2 displaces I_2.*
Iodine is displaced by bromine.
There is no suitable statement linking halide and halide.

[3]

(f)	MMO Collection	**FB 8** Observes white ppt soluble/dissolving/disappearing (in excess) for each reagent.	1	
		FB 9 Observes white ppt insoluble/not dissolving/remaining (in excess) for each reagent	1	
	ACE Conclusions	Mark consequentially on observations involving white precipitates only. Expected ions are Zn^{2+} in **FB 8** and Mg^{2+} in **FB 9** **Symbol and ion charge** must be correct in any deduction or the **name** of the ion given: *e.g. Zn^{2+} or zinc but **not** Zn*	1	[3]
				[Total: 13]