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

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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]

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(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]

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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]

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(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]

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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.*

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(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]

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(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]

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