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

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 $\dfrac{\textbf{42.75}}{\textbf{volume diluted}} \times \textbf{titre}$

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)**	<u>Both</u> burette readings in the dilution table and <u>final and initial</u> 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 <u>any</u> 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.)	3	
		step 1 $\dfrac{\textbf{titre}}{\textbf{1000}} \times \textbf{0.023}$		
		step 2 **5 e$^-$ in 1st eqn; 2 e$^-$ in 2nd eqn**		
		step 3 **× candidate's ratio** from step 2 The expected ratio is $^5/_2$		
		step 4 $\times \dfrac{\textbf{1000}}{\textbf{25}}$		
		step 5 $\times \dfrac{\textbf{250}}{\textbf{volume diluted}}$ [**or** (10 × step 3) $\times \dfrac{\textbf{1000}}{\textbf{volume diluted}}$]		
		step 6 **× 126**		
	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 $\Delta T/m$ correct to 2 d.p. for each experiment.

Candidate's scripts
Calculate $\Delta T/m$ correct to 2 d.p. for each experiment.
Record values of $\Delta T/m$ 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 $\Delta T/m$ 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, **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 $\Delta T/m$. 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 <u>1.0</u> °C. *Do not award this mark for an answer of 1.*	1	[1]

(f)	ACE Interpretation	Calculates $\dfrac{\textbf{candidates answer to (e)}}{\textbf{1.50}} \times \textbf{100}\%$ correct to:
		    2 significant figures (67%) **or**
		    3 significant figures (66.7%) **or**
		    4 significant figures (66.67%)
		 Accept $66\frac{2}{3}$.
			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)**.	1	
		Records all thermometer readings to (.0) or (.5) in **(a) and (h)**.	1	
		*Where the experiment in **(h)** has not been attempted, only the mark for consistent weighings may be awarded – from the experimental results in **(a)**.*		
				[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)**.	1	
		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 $\Delta T/m$. 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}	2	
				[3]
(k)	ACE Conclusions	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** $2\Delta H_2 = \Delta H_1 - \Delta H_3$	1	
	ACE Interpretation	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 $\Delta T/m$ but may then correctly round their answer to at least 3 significant figures.*	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:** HCl; NaOH(aq); NH$_3$(aq); BaCl_2/Ba(NO$_3$)$_2$(aq); Pb(NO$_3$)$_2$(aq); AgNO$_3$(aq); K$_2$Cr$_2$O$_7$(aq); Br$_2$(aq); concentrated H$_2$SO$_4$		
	MMO Decisions	**(i)** Selects AgNO$_3$ as one reagent **and** NH$_3$(aq) added <u>to the ppt produced with AgNO$_3$</u> **or** Pb(NO$_3$)$_2$ / K$_2$Cr$_2$O$_7$ added as <u>fresh</u> 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	
				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$_2$Cr$_2$O$_7$	*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.*		
	ACE Conclusion	**(iv)** Makes appropriate <u>consequential</u> 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]

(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** Give **one mark** for **three** out of four correct marking points for **FB 7**	1 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 Sulfuric acid is an oxidising agent. *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: 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.*	1 1 1	
				[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]