UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Subsidiary Level and GCE Advanced Level

MARK SCHEME for the May/June 2010 question paper

for the guidance of teachers

9701 CHEMISTRY

9701/34 Paper 32 (Advanced Practical Skills), 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.

Mark schemes must be read in conjunction with the question papers and the report on the examination.

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UNIVERSITY of CAMBRIDGE
International Examinations

Question 1 Round all thermometer readings to the nearest 0.5°C.

Question	Sections	Indicative material	Mark	
1 (a)	PDO Recording	**(i)** Presents data in single table of results – *to include masses of tube with solid and residue, (mass of solid), initial and final temperatures and temperature change.*	1	
		(ii) All columns correctly labelled with appropriate unit shown. *Must use solidus, brackets or describe unit fully in words. There must be at least one mass and one temperature.* *If units not included in column headings every entry must have the correct unit shown.*	1	
	MMO Collection	**(iii)** All balance readings recorded to 1 or more decimal places and showing same precision of measurement	1	
		(iv) All thermometer readings recorded to 0.5°C (must be at least one at 0.5°C)	1	
	MMO Decisions	**(v)** Two additional masses of $NaHCO_3$ evenly spaced between the other readings **or** one or both extending the plot (**Not** two between same pair) (**Not** within 0.5 g of any other) (**Not** >3.0 g away from any other)	1	
	MMO Quality	**(vi) and (vii)** Check and correct ΔT where necessary. Compare temperature fall with that obtained by the Supervisor for **FB 2** Award **(vi) and (vii)** for a temp fall difference of 0.0°, 0.5° or 1.0°C Award **(vi) only** for a difference of 1.5°C	2	
		(viii) and (ix) Check and correct ΔT where necessary. Compare temperature fall with that obtained by the Supervisor for **FB 3** Award **(viii) and (ix)** for a temp fall difference of 0.0°, 0.5° or 1.0°C Award **(viii) only** for a difference of 1.5°C	2	[9]

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Question	Sections	Indicative material	Mark	
(b)	PDO Layout	**(i)** Temperature (fall) plotted on *y-axis* against mass of sodium hydrogencarbonate on *x-axis*. Clearly labelled axes (ignore units unless T/δT/θ or m as labels) Award even if final temp plotted	1	
		(ii) Uniform and sensible scales that allow points to be plotted in at least half of the squares on each axis. (6 × 4 big squares)	1	
		(iii) check the "sweep" that points plotted for all experiments recorded. Check the plotting of points for **FB 1**, **FB 2** and **FB 3** (and any other "suspect" point). *Points should be within ½ of a small square, in the correct half of the small square*. **Not** awarded if final T is plotted **Not** awarded if only **FB 1**, **FB 2** and **FB 3** are recorded	1	
		(iv) Straight line drawn, passing within ½ small square of the origin and close to the majority of the points	1	[4]
(c)	PDO Layout	Explains that the mass of sodium hydrogencarbonate is the independent (controlled) variable **or** Temperature change is the dependent variable *(or words to that effect)*	1	[1]
(d)	ACE Conclusion	Gives correct equation for the reaction $NaHCO_3 + HCl \rightarrow NaCl + H_2O + CO_2$ (Not H_2CO_3) *(Ignore state symbols)*	1	[1]
(e)	PDO Display	Construction on graph for determining the gradient clearly shown *(Must span at least 3 large squares in each direction)* **and** working shown for calculation *(could be found on graph page)*	1	
	ACE Interpretation	Reads intercepts **or** selects two points <u>on the line</u> to within ½ small square in either direction.	1	
		Evaluates Δ**y**/Δ**x** from candidate's intercept figures to find gradient correctly to sf shown	1	[3]
(f)	ACE Interpretation	Multiplies answer to **(e)** by 84	1	[1]
(g)	ACE Interpretation	Some use of 30 × 4.3 × (answer to **(f)**)	1	
	PDO Display	Answer, in kJ mol^{-1}, correct to 2 or 3 significant figures and showing +ve sign *Correct answer is given by 0.129 × answer to **(f)*** *(**No** ecf from first part)*	1	[2]

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Question	Sections	Indicative material	Mark	
(h)	ACE Improvements	Suggests use of a lid **and** increased/thicker insulation round the sides. *(Accept use of a vacuum flask for improved insulation.)*	1	[1]
(i)	ACE Improvements	Lower % error with burette **or** more accurately calibrated *(must refer to or infer scale/graduations/markings/divisions)*	1	[1]
(j)	ACE Interpretation	Maximum error in reading a balance reading to 1 decimal place is 0.05 g **and** Maximum error in reading a 1°C graduated thermometer is given as ±0.5°C Expected % errors 0.89/0.9 or 1.79/1.8% (correct for sf shown) for the balance **and** 8.3% for the thermometer. (allow ecf from first part – error (× 2)/0.056 and error × 2/0.12) *This section may be marked <u>horizontally</u> or <u>vertically</u>*	1 1	[2]
(k)	ACE Interpretation	Systematic error stated (or explained in other words)	1	[1]
	Total		**[26]**	

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Question 2

Question	Sections	Indicative material	Mark	
FB 7 is $(NH_4)_2SO_4.FeSO_4(aq)$; **FB 8** is $NH_4Cl(aq)$				
2 (a)	MMO Decisions	Chooses barium chloride (or nitrate)/ $Ba^{2+}(aq)$/solution containing Ba^{2+} (ions) followed by a <u>specified</u> mineral acid other than sulfuric acid **or** vice versa. (Allow if acid name specified in **(b)**) Do not accept lead nitrate/lead ions	1	[1]
(b)	PDO Recording MMO Collection	Results for two solutions and two reagents (ecf from **(a)**) recorded in a single table with distinct separation between reagents (no repetition of solutions or reagents) Give one mark for correct observations with **FB 7** and **FB 8** Expected results: **FB 7** – white ppt with Ba^{2+}, insoluble in acid *(do not award if H_2SO_4 added)* **FB 8** – No reaction **or** no precipitate If Pb^{2+} used then white ppt with both or obs as for Ba^{2+} *Do not award if any obs are dashes **except** for **FB 8** adding acid after Ba^{2+}*	1 1	[2]
(c)	ACE Conclusion	Mark consequentially on observations in **(b)** Expected conclusion Identifies **FB 7** as solution containing SO_4^{2-} from "white ppt with Ba^{2+}, insoluble in acid given in evidence *ecf allowed here. Allow deduction if H_2SO_4 has been added **after** Ba^{2+} (not with Pb^{2+})*	1	[1]
(d)	MMO Collection	One mark for two correct observations with NaOH(aq) – before heating **FB 7** – green/dirty green/muddy green ppt **FB 8** – no ppt/no change/no reaction ***The mark from (e) may be awarded here if the green ppt with FB 7 is recorded as <u>turning brown</u>*** One mark for correct observations with NaOH(aq) – after heating gas evolved turns red litmus paper blue for **both FB 7** and **FB 8** One mark for correct observations with $NH_3(aq)$ **FB 7** – green ppt (as above) **FB 8** – no ppt/no change/no reaction	1 1 1	[3]
(e)	MMO Collection	Records brown precipitate/residue provided <u>green ppt</u> in first box of **(d)**	1	[1]

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Question	Sections	Indicative material	Mark	
(f)	ACE Conclusions	Mark consequentially on observations in **(d)** and **(e)** Expected conclusions: **(i)** Common cation is ammonium/NH_4^+, from evolution of ammonia or alkaline gas (minimum) or clear ref back to relevant obs **(ii)** Second cation is Fe^{2+} in **FB 7** from green ppt with NaOH **and** NH_3 **or** green ppt, turning brown, with either. If Cr^{3+} then grey-green ppt with both alkalis **or** grey-green ppt with NaOH soluble in excess giving (dark) green solution **or** grey-green ppt insol in excess NH_3 (**no con obs**)	1	[1]
FB 9 is a ketone; **FB 10** is a primary alcohol; **FB 11** is a secondary alcohol; **FB 12** is an aldehyde				
(g)	MMO Collection	One mark for correct observations with **FB 9** and **FB 12** One mark for two correct observations with **FB 10** One mark for two correct observations with **FB 11** See table below for expected observations	1 1 1	[3]

reagent	**observations**			
	FA 9	**FA 10**	**FA 11**	**FA 12**
acidified dichromate	no reaction/no change/yellow or orange soln (**not** no ppt*)	(colour change to) green/blue-green/ cyan/turquoise (solution **not** ppt*)	(colour change to) green/blue-green/ cyan/turquoise (solution **not** ppt*)	*penalise ppt error once in this row If **FB9** colour wrong penalise 1st of additional ppts
2,4-DNPH	~~yellow ppt~~		~~no reaction/ no change~~	~~yellow ppt~~
Tollens' reagent		no reaction/ no change/no ppt	no reaction/ no change/no ppt	silver mirror **or** black/grey solution or ppt

(h)	ACE Conclusions	Mark consequentially on observations in **(g)** **FB 10** and **FB 11** contain the alcohols from both **oxidised** by dichromate(VI) **and** give no ppt with Tollens' **FB 9** contains the ketone from No reaction with dichromate ($Cr_2O_7^{2-}$ obs all correct) **or** no reaction with $Cr_2O_7^{2-}$ **and** yellow ppt with 2,4-DNPH. (If **FB 12** selected evidence must have yellow ppt with 2,4-DNPH **and** no reaction with Tollens')	1 1	[2]
	Total			**[14]**

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