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

9701/35 Paper 31 (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

Question	Sections	Indicative material	Mark	
1 (a)	MMO Collection	**(i)** Follows instructions with regard to weighings and mass of $NaHCO_3$ *2 balance readings and mass of $NaHCO_3$* **and** times and temperature readings *0–3 minutes at 1 minute intervals;* *5–8 minutes at ½ minute intervals*	1	
	PDO Recording	**(ii)** All columns correctly labelled with appropriate unit shown. *Must use solidus, brackets or describe unit fully in words.* *If units not included in column headings every entry must have the correct unit shown* Accept min, mins or minutes	1	
		(iii) *Look at results here and in* **(d)**. All **balance readings** consistent to at least 1 decimal place. **and** All **thermometer readings** recorded to nearest 0.5°C. There must be at least one at 0.5 in **(a).**	1	[3]

Question	Sections	Indicative material	Mark	
(b)	PDO Layout	**(i)** Temperature of acid/solution in the beaker plotted on *y-axis* against time on *x-axis.* Clearly labelled axes (ignore units) *[temp/time are minimum acceptable labels]* *but* *accept* **T / °C** *and* **t / min** *as labels. The unit is necessary in this case*	1	
		(ii) Uniform and sensible scales for candidate's choice of graph. Plotted points must be in at least 5 large squares on the temperature axis and 5 large squares on the time axis.	1	
		(iii) *There should be a minimum of 5 plotted points between 5 and 8 minutes.* **Examiner then checks plotting of points at $t_{0\ min}$, $t_{5\ min}$ and $t_{8\ min}$ and the plotting of any suspect point.** **If any of the $t_{0\ min}$, $t_{5\ min}$ and $t_{8\ min}$ points is missing check the adjacent point.** *Points should be within ½ of a small square of the correct position and in the correct small square*	1	
	ACE Interpretation	**(iv)** Acceptable straight lines drawn – *an acceptable straight line is one passing through the majority of points or has balanced points on either side of the line* **and** correct values of the minimum and maximum temperatures at t = 4 minutes are read (to within ½ small square) from the graph. *Extrapolation need not be drawn on the graph*	1	[4]
(c)	ACE Interpretation	**(i)** No mark.		
		(ii) The candidate <u>correctly</u> calculates (to sig figs displayed) the moles of **FA 1** used, *(cand mass of **FA 1**/84)*	1	
		(iii) The candidate correctly divides their answer to **(i)** by their answer to **(ii)** and by 1000. *Ignore errors in evaluation and sign.*	1	
	ACE Conclusions	**(iv)** Award this mark if the candidate has given a +ve sign **and** explains that: the reaction is endothermic **or** heat is absorbed in the reaction **or** the temperature falls during the reaction	1	[3]

Question	Sections	Indicative material	Mark	
(d)	MMO Quality	**Compare the two ΔT/m values (°C g^{-1}) for the candidate's two experiments.** Award **three** marks for a difference up to **0.2** Award **two** of these three marks for a difference of **0.2+ °C – 0.3** Award **one** of these three marks for a difference of **0.3+ °C – 0.4** **Compare the <u>standard</u> m/ΔT value of 1.55°C g^{-1} with the closer value from the candidate's results.** Award **three** marks for a difference up to **0.2** Award **two** of these three marks for a difference of **0.2+ °C – 0.3** Award **one** of these three marks for a difference of **0.3+ °C – 0.4**	3 3	[6]
(e)	ACE Interpretation	**(i)** No mark is awarded for this section **but check that temperature rise from expt 1 has been used** **(ii)** The candidate <u>correctly</u> calculates (to sig figs displayed) the moles of **FA 2** used in expt 1. ***Do not award this mark if data from expt 2 has been used in (i) or (ii).*** **(iii)** The candidate correctly divides the answer to **(e)(i)** by the answer to **(e)(ii)** and by 1000. *Ignore errors in evaluation and sign*	 1 1	
	ACE Conclusions	**(iii)** Award this mark if the candidate has given a –ve sign **and** explains that: the reaction is exothermic **or** heat is released in the reaction **or** the temperature rises during the reaction	1	
	PDO Display	Award this mark if working is shown in sections **(c)(ii)**, **(c)(iii)**, **(e)(ii)** and **(e)(iii)** Award this mark if the final answer in section **(c)(iii)** and **(e)(iii)** is given to 2 or 3 sig fig.	1 1	[5]
(f)	ACE Interpretation	Correctly calculates $\Delta H_{decomposition}$ from candidate values in **(c)(iii)** and **(e)(iii)**. Allow (±1) on final significant figure given The answer given must include a mathematically correct sign	1	[1]
(g)	ACE Interpretation	Correctly calculates the difference and the percentage error. *Ignore significant figures.*	1	[1]

Question	Sections	Indicative material	Mark	
(h)	ACE Conclusions	Clearly described source of error **(i)** Heat loss / gain **(ii)** Precision of thermometer **(iii)** Acid spray **(iv)** Use of a glass beaker	1	
	ACE Improvements	Specific improvement given with some attempt at justification. **(i)** Lid – prevents convection or evaporation Insulation – prevents conduction **(ii)** Use thermometer at 0.5°C or better, gives smaller % error. **(iii)** Lid – acts as a physical barrier **(iv)** Use of plastic cup – better insulator or lower (specific) heat capacity **Do not credit either mark for answers referring to use of measurement of volume or measurement of mass.**	1	[2]
	Total			**[25]**

Question 2

Question	Sections	Indicative material	Mark	
2 (a)	MMO Decisions	**(i)** **reagent 1** – chooses any **specified acid** to detect the carbonate present *(name or formula* may be in results table) **and** **reagent 2 –** chooses $AgNO_3$. *Accept Ag+(aq) or soln containing Ag^+ as reagent.* *Also accept incorrect formulae for a compound, e.g. $Ag(NO_3)_2$, providing the identity of the reagent is obvious.*	1	
		(ii) Explains significance of order in which reagents added. acid first – to remove carbonate from solution **or** after Ag^+ – to dissolve any silver carbonate precipitated. **Candidates must make clear the relationship of acid to silver carbonate.** *Do **not** award this mark if hydrochloric acid has been used in* **(i)**	1	
		In section **(iii)**, assume reagents follow each other in the same test-tube unless otherwise stated. ***Allow lead(II) nitrate as the 2nd reagent providing it is used with nitric acid.***		
	MMO Collection	**(iii)** **Addition of acid** No reaction with **FA 4**, effervescence/bubbles/bubbling (or gas tested with limewater) for **FA 5 and FA 6**	1	
		Addition of Ag^+(aq) ***Ignore any addition of NH_3(aq) after Ag^+*** white ppt with **FA 4**, if added as first reagent or to a separate sample *Allow off-white to brownish ppt with **FA 6*** **or** white ppt, insoluble in acid for **FA 4**, soluble in acid for **FA 6** and insoluble/partially soluble in acid for **FA 5** if added before the addition of acid **or** white ppt with **FA 4** and **FA 5** and no ppt with **FA 6** if added after addition of acid *Do **not** award this mark if hydrochloric acid has been used **unless** it has been stated that Ag^+(aq) was added to a **fresh sample***	1	
		Allow deductions from lead nitrate (as for silver salt) ONLY if nitric acid has been specified		

Question	Sections	Indicative material	Mark	
2 (a) contd	ACE Conclusions	**No ecf to be applied in these conclusions** **(iv)** Give **one mark** for identifying carbonate in **FA 5** and **FA 6**, with supporting evidence. Minimum acceptable evidence – gas with acid **or** off-white, white, cream. brownish ppt (silver carbonate) soluble in acid *Do **not** award this mark from the colour of the precipitate alone.* Give **one mark** for identifying chloride in **FA 4** and **FA 5 only**, with supporting evidence. Minimum acceptable evidence – white ppt with Ag^+ (if insoluble in acid) but **con** if soluble. *Do **not** award this mark from the colour of the precipitates with Ag^+ alone* If no mark has been awarded in **(iii)** or **(iv)**, allow one mark if evidence given is consistent with the ions identified	1 1	[6]
FA 7 is A*l*K$(SO_4)_2$(aq); **FA 8** is NiC*l*$_2$(aq); **FA 9** is CrC*l*$_3$(aq); **FA 10** is Pb$(NO_3)_2$(aq)				
(b)	MMO Collection	For **FA 7**, records **(i)** white ppt, soluble in an excess of NaOH **and** white ppt, insoluble in excess ammonia For **FA 8**, records **(ii)** green ppt, insoluble in an excess of NaOH **and** Dark or deep blue solution with (excess) ammonia **or** Initial blue solution, darkening with excess of the reagent For **FA 9** records **(iii)** grey-green ppt, soluble in an excess of NaOH to give a dark green solution **(iv)** grey-green ppt, insoluble in excess ammonia For **FA 10**, records **(v)** white ppt, soluble in an excess of NaOH **and** white ppt, insoluble in excess ammonia	1 1 1 1 1	

Question	Sections	Indicative material	Mark	
(b) contd	MMO Decisions	**(vi)** Selects hydrochloric acid, sulfuric acid potassium iodide, potassium chromate (or dichromate) as suitable reagent **Not barium chloride** ***If no reagent is chosen, a retrospective De7 mark can be given here for testing gas evolved with limewater in* (a)**	1	
	MMO Collection	**(vii)** Observes appropriate ppt with chosen reagent and **FA 10** but not with **FA 7**. ***Do not award this mark if reagent is added to any solution recorded as giving a coloured ppt or no ppt with NaOH or with NH_3 or barium chloride is used***	1	[7]
(c)	ACE Conclusions	**No ecf to be applied in these conclusions** Identifies all cations correctly: **FA 7** is Al^{3+} / aluminium **FA 9** is Cr^{3+} / chromium(III) **FA 10** is Pb^{2+} / lead *The correct ions must be identified for each solution.*	1	
		Gives appropriate supporting evidence for **two** of the three ions ***Allow evidence for reversed Al^{3+}/Pb^{2+} if barium chloride has been used*** Minimum evidence for each of the ions. **Al^{3+}** white ppt with NaOH and NH_3(aq); ppt soluble in excess NaOH, ppt insoluble in excess NH_3(aq) **and** no reaction with HCl, H_2SO_4, KI **Cr^{3+}** **(i)** grey-green ppt with both NaOH and NH_3(aq), **or** **(ii)** grey-green ppt with NaOH, soluble in excess of the reagent, **or** **(iii)** grey-green ppt with NH_3(aq), insoluble in excess of the reagent, **or** **(iii)** Dark green solution with excess NaOH **Pb^{2+}** white ppt with NaOH and NH_3(aq); ppt soluble in excess NaOH, ppt insoluble in excess NH_3(aq) **and** white ppt with HCl or H_2SO_4 or yellow ppt with KI	1	[2]
	Total			**[15]**

If an appropriate reagent has been chosen but no observations recorded in **(b)(iii)**:
Allow deduction of the identity of the ions if the observations have been correctly recorded in the evidence section
Do **not** however award the mark for appropriate evidence – from observations