UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Subsidiary Level and GCE Advanced Level

MARK SCHEME for the October/November 2007 question paper

9701 CHEMISTRY

9701/32 Paper 32 (Practical 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.

All Examiners are instructed that alternative correct answers and unexpected approaches in candidates' scripts must be given marks that fairly reflect the relevant knowledge and skills demonstrated.

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

- CIE will not enter into discussions or correspondence in connection with these mark schemes.

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UNIVERSITY of CAMBRIDGE
International Examinations

Generic Mark Scheme

Skill		***Breakdown of marks***	
Manipulation, measurement and observation	16 marks	Successful collection of data and observations	8 marks
		Decisions relating to measurements or observations	8 marks
Presentation of data and observations	12 marks	Recording data and observations	5 marks
		Display of calculation and reasoning	3 marks
		Data layout	4 marks
Analysis, conclusions and evaluation	12 marks	Interpretation of data or observations and identifying sources of error	6 marks
		Drawing conclusions	5 marks
		Suggesting improvements	1 mark

Question	Sections	Indicative material	Mark	
Round all recorded times in Supervisor and candidate scripts to the nearest second. List on the Supervisor's script the rounded times for experiments 1 and 2 for each candidate.				
1 (a)	MMO Collection	Performs experiments and records times for each reaction. Follows instructions. Award this mark if the reaction time for experiment 2 is within 20% of that obtained for experiment 2 by the Supervisor (or the majority of candidates in the Centre).	1 1	[2]
1 (b)	PDO Recording	**(i)** Single table for all experiments performed. *(Experiments 1 and 2 must be included; minimum for table is volume and time for experiments 1 and 2)* *A single table has no repetition of headings.* **(ii)** Table has been drawn up in advance. *(must have minimum of 4 experiments tabulated* *– does not have to include experiments 1 and 2)* – volumes of **FB 4** are sequential. Experiments 1 and 2 may be entered first or last. **(iii)** Table includes columns for volume of **FB 4** or log(volume of **FB 4**), time, $^1/_t$ or log($^1/_t$). *Ignore other columns* *or if total volume in experiment ≠ 81* **(iv) Ignore log columns** All other columns correctly labelled with <u>appropriate unit</u> (2007 syllabus). Accept t but not T for time heading Accept cm^3, dm^3, s, s^{-1}, $^1/_s$ as units for units accept: *unit after solidus, unit in bracket or <u>in</u> words e.g. / cm^3; (cm^3) or* *volume in cubic centimetres* ***but not*** *volume cm^3* *If the unit is not included in the column heading, every entry in the column must have a unit.* **(v)** All times recorded to nearest second	1 1 1 1 1	

Question	Sections	Indicative material	Mark	
	Accuracy Calculate (vol of **FB 4** x time) for experiment 1 and the two additional experiments with greatest volume of **FB 4**. *(Round all times to the nearest second)* Record the Vt values against the appropriate experiment on the candidate's script.			
1 (b) contd.	MMO Decisions	**(vi)** At least 3 mixtures – in addition to experiment 1 and experiment 2.	1	
		(vii) Volumes of **FB 4** chosen are uniformly spaced over the whole range	1	
		(viii) and (ix) Award both of these marks if two of the Vt values are within 10% of the larger of the closest pair. *[Award point **(ix)** but **not** point **(viii)** for a difference of 10+% to 20%]*	2	
		(x) and (xi) Award both of these marks if candidate's time for experiment 1 is within 10% of that obtained by the Supervisor. *[Award point **(xi)** but **not** point **(x)** for a difference of 10+% to 20%]*	2	[11]
	Where experiment 1 has been repeated, assess accuracy using the time on page 3. Use the value on page 4 when checking the graph.			
1 (c)	PDO Layout	**Ignore labels** – check which numerical values have been plotted **Ignore** omission of negative signs; direction of numbers on axes etc.		
		Plots ***a rate*** ($^1/_t$ or (log $^1/_t$)) on *y*-axis and ***a concentration*** (volume of **FB 4** or (log volume of **FB 4**)) on *x*-axis *If labels correct but numbers on scale indicate a different quantity do **not** award this mark*	1	
		Easy to use scales chosen with plotted points covering more than ½ of each available axis	1	

Question	Sections	Indicative material	Mark	
1 (c) contd.	PDO Layout	A point must be plotted for each experiment performed – *take care where experiments 1 and 2 have been omitted from the main results table)* All points plotted to within ½ small square and in the correct half of a small square	1	
		Appropriate straight line drawn through the points. (*This does not have to be a "best-fit" line but must show correlation to the points plotted. Do **not** award this mark if there is clearly a better line that could have been drawn through the points)* A minimum of three points that lie close to the line are required – no *anomalous point is permitted where three points only have been plotted.* Do **not** award this mark if the line is drawn through points "bunched" in less than 20 x 20 small squares.	1	[4]
	If a candidate has only performed experiments 1 and 2 or if data has only been plotted for 2 experiments, points L4, L5 and L6 but **not** L7 can be awarded.			
1 (d)	PDO Display	Construction lines drawn on the graph. *The hypotenuse of the constructed "triangle" should cover at least half of the length of the line drawn by the candidate.*	1	
		Correctly reads (to nearest ½ small square) the coordinates from the graph *Accept values from the table if the line is drawn through the point.* *Do **not** penalise reuse of values for an incorrectly plotted point*	1	
	ACE Interpretation	Calculates gradient correctly to at least 1 decimal place using the values read from the graph by the candidate.	1	[3]
	Where data for two experiments **only** has been plotted, the Display marks **only** may be awarded. Do **not** award the Display mark for reading coordinates if either value is taken from the table.			

Question	Sections	Indicative material	Mark	
1 (e)	ACE Interpretation	Give one mark for an error of ± 0.25 cm^3 when reading a 25 cm^3 measuring cylinder Estimated and % errors 20 cm^3 in 25 cm^3 measuring cylinder: Correct % for error above. 1.00 cm^3 in burette: *single burette reading* 0.05 cm^3 **or** 0.10 cm^3 *two burette readings* 5% **or** 10% 20.00 cm^3 in burette: *single burette reading* 0.05 cm^3 **or** 0.10 cm^3 *two burette readings* 0.25% **or** 0.5% Consequential on calculations. *Measuring 1.00 cm^3 from burette should be most significant error.*	1 1 1	[3]
1 (f)	ACE Improvements	Has: Volume of **FB 4** < 20 cm^3, variable volume of **water**, water to keep total combined volume (**FB 4** and water) constant at 40 cm^3. Record the volume of (**FB 4** + water) for each experiment to the left of the table.	1	[1]
1 (g)	PDO Display	Uses experimental data to make appropriate comment, from experimental results, as to how **rate** varies with concentration of KI. *[Do not give this mark where mixtures selected in **(f)** are not appropriate, i.e. the volume of (**FB 4** + water) $\neq 40$ cm^3]* *Where an acceptable qualitative statement has been given ignore any incorrect attempt at a quantitative/mathematical expression.*	1	[1]
Qn 1	**Total**		**25**	

Question	Sections	Indicative material	Mark	
FB 5 is aqueous nickel(II) sulphate, FB 6 is aqueous copper(II) chloride, FB 7 is aqueous chromium(III) chloride, FB 8 is solid 2-hydroxybenzoic acid (salicylic acid)				
2 (a)	MMO Decisions	Chooses $BaCl_2$/$Ba(NO_3)_2$ and HCl/HNO_3 (**not** H_2SO_4) as reagents	1	
	MMO Collection	Records white ppt with $BaCl_2$, insoluble in HCl for **FB 5** only (obs for **FB 6** and **FB 7** not required) *If acid is not specified – give this mark only if barium salt is added before the acid*	1	
	ACE Conclusion	Concludes that **FB 5** contains the sulphate ion Allow deduction from addition of barium salt without addition of acid *If no observations recorded this mark can be awarded if it is clear that the barium salt and appropriate acid are added to all three solutions.*	1	[3]
2 (a) alt	MMO Decisions	Chooses $AgNO_3$ and aqueous ammonia	1	
	MMO Collection	Records white ppt with $AgNO_3$, soluble in aqueous ammonia for **FB 6** and **FB 7** (obs for **FB 5** not required)	1	
	ACE Conclusion	Concludes that **FB 5** contains the SO_4^{2-} ion (by elimination) *Allow deduction from addition of silver salt without addition of aqueous ammonia*	1	
2 (b)	MMO Collection	Give one mark for the following observations on adding NH_3 NaOH **FB 5** green ppt green ppt **FB 6** blue ppt blue ppt **FB 7** grey-green ppt grey-green ppt	1	
		Give one mark for the following observations on adding excess reagent (excess is needed in recorded observation except where no ppt is recorded, correctly or incorrectly, on first addition of reagent) NH_3 NaOH **FB 5** (soluble) – blue solution insoluble **FB 6** (soluble) – dark blue solution insoluble **FB 7** insoluble (soluble) – dark green solution Where only one reagent has been used, one of the C3 marks above may be awarded for fully correct observations on adding the reagent to excess.	1	

Question	Sections	Indicative material	Mark	
2 (b) contd	ACE Conclusions	**FB 7** contains Cr^{3+} **FB 6** contains Cu^{2+}	1 1	[5]
	ACE Interpretation	Gives appropriate evidence for identification of the ions Minimum evidence for Cu^{2+} blue ppt with NaOH and with $NH_3(aq)$ or dark blue solution with excess $NH_3(aq)$ Minimum evidence for Cr^{3+} grey-green ppt with NaOH and with $NH_3(aq)$ or dark green solution with excess NaOH	1	
2 (c) (i)	MMO Decisions	Describes test for hydrogen	1	
	MMO Collection	Records a positive test for hydrogen Hydrogen/H_2 identified from "pop" alone	1	
(ii)	MMO Collection	(Solid dissolves in NaOH), white ppt on adding HC*l*, dissolves (again) in NaOH *Allow his mark if precipitate intensifies on adding acid and diminishes on adding NaOH*	1	
(iii)	MMO Collection	Evidence (from smell) of ester formation. *Accept liniment, hospital, antiseptic smell but **not** sweet or fruity*	1	
	ACE Conclusions	Give one mark for concluding that **FB 8** is an acid or solution is acidic	1	
		Give one mark for (aromatic) organic acid or carboxylate/carboxylic functional group	1	
	ACE Interpretation	Give one mark for any evidence supporting the conclusion of an acid/organic acid – flammable gas from reaction with magnesium, – solubility in NaOH; insolubility in HC*l* – ester formation *(allow from sweet or fruity smell)*	1	[7]
Qn 2	**Total**		**15**	