UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Subsidiary Level and GCE Advanced Level

MARK SCHEME for the May/June 2011 question paper

for the guidance of teachers

9701 CHEMISTRY

9701/34 Paper 32 (Advanced Practical Skills 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, 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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Question	Sections	Indicative material	Mark	
1 (a)	PDO Layout	**I** Volume given for Rough titre **and** accurate titre details tabulated. *Minimum of 2×2 "boxes".*	1	
	MMO Collection	**II** Follows instructions – dilutes 45.50–46.50 cm^3 **FB 1** **and** initial and final burette readings **and** volume of **FB 2** added recorded for each accurate **titre** (on page 3) *Headings should match readings. Ignore units. Acceptable headings: initial/final or 1st/2nd (burette) (reading)/(reading at) start/finish; volume added/used/ titre; or wtte [**not** "difference"] Do **not** award this mark if: 50(.00) is used as an initial burette reading; more than one final burette reading is 50.(00); any burette reading is greater than 50.(00)*	1	
	PDO Recording	**III** All accurate burette readings (initial and final) recorded to nearest 0.05 cm^3 (Accurate titration & dilution tables) *Assess this mark on burette readings only, ignore volumes of* **FB 1** *and* **FB 2** *added*	1	
	MMO Decisions	**IV** Has two uncorrected, accurate titres within 0.1 cm^3 *Do not consider the Rough even if ticked. Do **not** award this mark if having performed two titres within 0.1 cm^3 a further titration is performed which is more than 0.10 cm^3 from the closer of the initial **two** titres, unless a fourth titration, within 0.1 cm^3 of the third titration (or first two) has also been carried out.*	1	

Round any burette readings to the nearest 0.05 cm^3.
Check and correct, if necessary, subtractions in the titre table.
Examiner then selects the "best" titre using the hierarchy:
two identical; titres within 0.05 cm^3; titres within 0.1 cm^3; etc

$$\text{Calculate candidate titre} \times \frac{\text{candidate volume added}}{\text{Supervisor volume added}}$$

Calculate difference in Supervisor and candidate scaled values and award "quality" marks as below.
[If candidate has not recorded a volume diluted, use 46.00 cm^3]

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Question	Sections	Indicative material	Mark	
	MMO Quality	**V**, **VI** and **VII** Award **V**, **VI** and **VII** for a difference from Supervisor within 0.20 cm^3 Award **V** and **VI** only for 0.20 < δ 0.40 cm^3 Award **V** only for 0.4 < δ 0.6 cm^3 *Apply spread penalty as follows:* *If titres selected (by Examiner) differ 0.60 cm^3* *cancel one of the Q marks*	1 1 1	[7]
(b)	ACE Interpretation	Calculates the mean, correct to 2 decimal places (third decimal place may be rounded up to the nearest 0.05 cm^3) from any **accurate** titres within 0.20 cm^3. *A mean of exactly .x25 or .x75 is allowed but the candidate may round up* to *.x3 or .x8 or to the nearest 0.05 cm^3.* *If **ALL** burette readings are given to 1 decimal place then the mean can be given to 1 decimal place* if numerically correct without rounding. *Mean of 24.3 and 24.4 = 24.35 (✓)* *Mean of 24.3 and 24.4 = 24.4 (✗)* ***Titres to be used in calculating the mean must be clearly shown – in an expression or ticked in the titration table.*** *Allow ecf from subtraction error for titre*	1	[1]
(c)	ACE Interpretation PDO Display	**I** correctly evaluates 1.25×10^{-4} **II**, **III**, **IV** are awarded for the correct expression but with no extra steps **or** for the correct answer if no working shown. **II** answer to **(i)** × 2.5 (3.125 or 3.13×10^{-4}) **and** answer to **(ii)** × 2 (6.25×10^{-4}) **III** Answer to **(iii)** × 250/mean titre in **(b)** **IV** Answer to **(iv)** × 1000/volume diluted **V** Working shown in a minimum of 4 steps *working must be in the right direction:* **(i)** *0.005 × 25* **(ii)** *indicate use of mole ratio (× 5/2 or 2/5)* *(If iodide used then × 5 or /5)* **(iii)** *use of × 2 or × 1/2* *(If iodide used then × 2/2 **not** × 1)* **(iv)** *answer to* **(iii)** × *250 **or** **(iii)**/mean titre* **(v)** *answer to* **(iv)** *and volume diluted used in denominator* **(vi)** All final answers to steps to 3 or 4 sf (minimum of 3 steps)	1 1 1 1 1 1	[6]
(d)	ACE Interpretation	(0.06/25) × 100 (= 0.24%) **and** (0.10/titre in **(b)**) × 100 *(only expressions needed)*	1	[1]
				[Total: 15]

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Question	Sections	Indicative material	Mark	
2 (a)	PDO Recording	**I** Records volume of **FB 6**, *t* and 1/*t* unambiguously for the four experiments *Do **not** award if t is not to the nearest second*	1	
		II Correct headings and units: volume (cm^3) or $/cm^3$ or volume in cubic centimetres/cm^3; time (s) or /s or time in seconds/s; 1/time (s^{-1}) or $/s^{-1}$ or 1/time or rate in per second	1	
	MMO Decisions	**III** Selects two volumes of **FB 6** one between 25–30 cm^3 and one between 35–40 cm^3 **and** sufficient water to make the solutions up to 45 cm^3 before adding acid **or** between 30–35 and 10–15 with corresponding volumes of water.	1	
	Examiner corrects any fractional times to the nearest second for 45 cm^3 and 20 cm^3 of **FB 6** and calculates t_{20}/t_{45} to 2 dp			
	MMO Quality	Award **IV** only if 1.90 t_{20}/t_{45} 2.60 Award **IV** and **V** if 2.10 t_{20}/t_{45} 2.40	1 1	[5]
(b)	ACE Conclusions	Volume of **FB 6** is directly proportional to its concentration (if total volume is constant) **or** to keep the concentration of **FB 5** constant **or** to keep the depth constant	1	[1]
(c)	ACE Conclusions	Rate of reaction is proportional to concentration of **FB 6** (*allow directly proportional)* **or** increase in **concentration** increases **rate** or **1/*t***	1	[1]
(d)	ACE Interpretation	**Either** shortest time as greatest **percentage**/ **fractional** error **or** longest time as greatest uncertainty in judging when printing is obscured	1	[1]
(e)	ACE Improvements	Keep volume of thio/**FB 6** constant, change volume of acid/**FB 5** and (add water to) make total volume constant **or** use different concentrations of acid/**FB 5** and keep the volume of it and the thio/**FB 6** constant	1	[1]
				[Total: 9]

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Question	Sections	Indicative material	Mark	
FB 7 is $Al_2(SO_4)_3$, **FB 8** is $Zn(NO_3)_2$, **FB 9** is $Pb(NO_3)_2$, **FB 10** is anhydrous $NaHCO_3$				
3 (a)		*Do not allow a dash for 'no reaction' except for* **FB 8** *with 2nd reagent provided NH_3 obs correct.*		
	PDO Layout	**I** Unambiguous layout of all (six minimum unless as above) observations with the two reagents *independent of reagents chosen*	1	
	MMO Decisions	**II** Chooses NH_3 **and** $KI/K_2CrO_4/H_2SO_4/HCl$ *(allow sodium/potassium dichromate)*	1	
	MMO Collection	**III** three white ppts with NH_3	1	
		IV Three correct obs **FB 7**: ppt insol in excess NH_3, **FB 8**: ppt soluble in excess NH_3, **FB 9**: ppt insol in excess NH_3	1	
		V three correct obs for a suitable reagent Expected obs: **FB 7** and **FB 8** no reaction, no change, no ppt, and **FB 9** white or yellow ppt depending on reagent *Allow obs mark if $BaCl_2$ used as 2nd reagent: white ppt with* **FB 7**, *no ppt with* **FB 8** *and white ppt or no ppt with* **FB 9**. *(If three reagents used mark obs for the two specified on 'reagent' line.)* *If any solutions appear to have been transposed, mark strictly as mark scheme.*	1	[5]
	(b)	ACE Conclusions	**FB 7** contains Al^{3+}/aluminium (ions) as (white) ppt insoluble in excess NH_3 and no reaction with 2nd reagent	1	
		FB 8 contains Zn^{2+}/zinc (ions) as (white) ppt soluble in excess NH_3	1	
		FB 9 contains Pb^{2+}/lead (ions) as ppt with 2nd reagent *Only penalise missing charge once.* *If NaOH used as 2nd reagent allow* ***1st*** *mark if* ***both*** *Al^{3+} & Pb^{2+} specified for* **FB 7** ***and*** **FB 9**, *(***FB 8** *mark is still available)* *The evidence for* **FB 7** *and* **FB 9** *may come from a third reagent (if used)* *For 'transposed' solutions, if conclusions are valid for the obs given, a maximum of 2 marks may be awarded.* *If $BaCl_2$ used and* ***only*** *white ppt with* **FB 7** *then allow* **FB 7** *as Pb^{2+}. If* ***two*** *(white) ppts both unknowns should be Pb^{2+}* ***or*** *Al^{3+}/Pb^{2+}.*	1	[3]

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Question	Sections	Indicative material	Mark	
(c)	MMO Collection	**(i)** Steam/water vapour/misty vapour/condensation/ droplets of liquid/water **or** lime water turns milky/cloudy white **(ii)** (pale) blue/green ppt/solid *(ignore effervescence)* **(iii)** effervescence/fizzing/bubbling *(ignore any reference to ppt)* **(iv)** white ppt **and** **either** effervescence (with acid) **or** (colourless) solution/ppt or solid dissolves **(v)** solid/ppt **turns** black/dark green/ darkens in 2nd box *Allow **is formed/changes to***	1 1 1 1 1	[5]
(d)	ACE Conclusions	**(i)** CO_3^{2-} from limewater turning milky in **any** part of **(c)** **or** fizzing/effervescence with acid *Allow SO_3^{2-} from correct obs in **(c)(iv)*** **(ii)** thermal decomposition **or** loss of water of crystallisation/dehydration (if CO_2 not tested for) **(iii)** effervescence suggests $Al^{3+}(aq)/Al_2(SO_4)_3$ is acidic **or FB 10** contains Ba^{2+} or Pb^{2+} (both needed) if white ppt recorded **or** CO_2 (produced) as limewater turns milky/cloudy white/forms white ppt **or** endothermic if cooling noted in **(c)(iii)**	1 1 1 	[3]
				[Total: 16]

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