CAMBRIDGE INTERNATIONAL EXAMINATIONS
Cambridge International Advanced Subsidiary and Advanced Level

MARK SCHEME for the October/November 2014 series

9701 CHEMISTRY

9701/34   Paper 3 (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 should be read in conjunction with the question paper and the Principal Examiner Report for Teachers.

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Question	Indicative material	Mark	Total
1 (a)	**I** The following data is shown • two burette readings for the rough titration • titre for rough titration • initial **and** final burette readings for **two** (or more) accurate titrations *(i.e. 2 × 2 "box")*	1	
	II Appropriate headings and units for accurate titration **and** volume **FB 1** added recorded for each accurate titre. Headings should match readings. • initial/start **and** (burette) reading/volume • final/end **and** (burette) reading/volume • titre **or** volume/**FB 1** **and** used/added unit/cm^3 **or** (cm^3) **or** in cm^3 **or** cm^3 for **each** entry	1	
	III All accurate burette readings are to the nearest 0.05 cm^3. *The requirement to record to 0.05 applies to burette readings, including 0.00 cm^3 (if this was the initial reading),* *but it does **not** apply to the titre.* *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	
	IV There are two uncorrected **accurate** titres within 0.10 cm^3 • *Do **not** include a reading if it is labelled "rough".* • *Do **not** award this mark if, having performed two titres within 0.10 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 further titration, within 0.10 cm^3 of any other, has also been carried out.* • *Do **not** award the mark if any 'accurate' burette readings (apart from initial 0) are given to **zero** dp.*	1	
	Examiner rounds any burette readings to the nearest 0.05 cm^3 and then selects the 'best' titres using the hierarchy: • two (or more) accurate identical titres (ignoring rough), then • two (or more) accurate titres within 0.05 cm^3, then • two (or more) accurate titres within 0.10 cm^3 etc. These best titres are used to calculate the mean corrected titre to the nearest 0.01 cm^3.		
	Award **V**, **VI** and **VII** if δ ≤ 0.20 (cm^3) Award **V** and **VI** if 0.20 < δ ≤ 0.40 Award **V**, only, if 0.40 < δ ≤ 0.80 ***Spread penalty:*** *if the two "best" (corrected) titres used by the Examiner were ≥ 0.50 cm^3 apart, cancel **one** Q mark.*	1 1 1	[7]

Question	Indicative material	Mark	Total
(b)	• Candidate averages two (or more) titres where the total spread is ≤0.20 cm^3. • Working must be shown **or** ticks must be put next to the two (or more) accurate readings selected. • The mean should be quoted to **2 dp**, and be correctly rounded to nearest 0.01 cm^3. Two special cases, where the mean need not be to 2 dp: • Allow mean to 3 dp **only** for 0.025 or 0.075 *(e.g. 26.325 cm^3)* • Allow mean to 1 dp, if **all** accurate burette readings were given to 1 dp **and** the mean is **exactly** correct. ***Note***: *the candidate's mean will sometimes be marked correct even if it was different from the mean calculated by the Examiner for the purpose of assessing accuracy.*	1	[1]
(c) (i)	Number of moles of $KMnO_4$ used = $0.0250 \times \dfrac{\textbf{(b)}}{1000}$	1	
(ii)	**2**$KMnO_4$ + 5H_2O_2 + 3H_2SO_4 → K_2SO_4 + 2$MnSO_4$ + **8**H_2O + 5O_2	1	
(iii) + (iv)	(iii) number of moles of H_2O_2 (in 10 cm^3) = 2.5 × **(i)** (iv) number of moles of H_2O_2 (in 1.0 dm^3) = 100 × **(iii)** *Allow ecf in **(iii)** to incorrect equation*	1	
(v)	Concentration in **FB 3** = **(iv)** × 10	1	
(c)	Answers to parts **(i), (iii), (iv)** and **(v)** given to 3 or 4 sf *A minimum of 3 answers is needed to qualify for the mark.* ***All** answers given must have appropriate sig figs.*	1	[5]
Qn 1		Total	[13]

Question	Indicative material	Mark	Total
2 **(a)**	**I** Table of data, showing all of the following: • unambiguous headings (*ignore units*) • four initial temperature • four final temperatures • four temperature rises correctly calculated *All data must be tabulated in the space provided on page 4.*	1	
	II Recording of data • correct units 'covering' all temperature readings. • all readings recorded to .0 or .5 °C, with at least one shown as .5 °C or .0 °C *Minimum of six temperatures required to qualify*	1	
	• Examiner checks Supervisor's subtraction for temperature rise for experiment **4**. • Examiner corrects thermometer readings to nearest .5 °C then subtracts. • Examiner calculates the difference between the [corrected] candidate's and Supervisor's temperature rise for experiment **4**.		
	Award **III** if ΔT increases with increase in volume of **FA 3**. **Experiment 4** Award **IV** if $\delta \leq 2.0$ °C Award **V** if $\delta \leq 1.0$ °C *If expt **4** was not carried out, examiners may award mark **IV** if experiment **3** is within 1.0 °C of Supervisor.*	1 1 1	[5]
(b)	**I** Suitable axes and scales to graph • both axes clearly labelled (units not required) • temperature (rise) as *y*-axis • suitable linear scales (*Points are plotted using more than half of the grid in both directions from* (0,0). *Must have at least one point plotted.*)	1	
	II Four points plotted clearly and correctly (All points plotted to within half a square and in the correct square for *y*-axis and on line for *x*-axis.)	1	
	III 0,0 point either plotted **or** used for line (within one small square)	1	
	IV Best fit line • Minimum 4 points on the grid are needed. This may include (0,0) if plotted. • Points above and below best fit line are "balanced".	1	[4]
(c) (i)	Correctly calculates temp rise per cm^3 (gradient of straight line) • All points from the best fit line must be correctly read to the nearest half square. • Points used must differ by a minimum of **two** large squares, along each axis.	1	

(ii)	Heat produced = 50 × 4.2 × temp rise calculated in **(i)**	1	
(iii)	Number of moles of H_2O_2 = 0.0010 × **1(c)(v)** (2, 3 or 4 sig fig)	1	
(iv)	Correct expression including negative sign and evidence of ÷ 1000 $\Delta H = -\dfrac{\textbf{(ii)}}{1000 \times \textbf{(iii)}}$ **or** correct answer	1	[4]
(d)	The **first** experiment, because it has the smallest temperature rise so greatest % error **or** smallest volume of **FA 3**/H_2O_2 so greatest % error. **or** The **final** experiment because it has the greatest heat loss. **or** Identifies experiment giving **most** anomalous point on graph.	1	[1]
Qn 2		**Total**	**[14]**

Question			Indicative material	Mark	Total
			FB 6 is $(NH_4)_2Fe(SO_4)_2$; **FB 7** is KI; **FB 8** is HCl; **FB 9** is $AgNO_3$		
3	**(a)**	**(i)**	Green precipitate, insoluble in excess (NaOH)	1	
			(When mixture heated) gas/ammonia turns (red) litmus blue	1	
			Either cation in **FB 6** identified from correct observations • iron(II)/Fe^{2+} • Ammonium/NH_4^+	1	
		(ii)	**Both** observations are correct • Precipitate/solid goes brown/red-brown/rust • Bubbles/fizzing/effervescence (*not "gas formed"*)	1	
			Type of reaction **and** justification redox (**or** oxidation **and** reduction) with any of the following: • iron(II) ions converted to iron(III) ions • hydrogen peroxide converted to oxygen • colour change indicates different oxidation states **or** oxidation of Fe^{2+} to Fe^{3+} **or** reduction of H_2O_2 as Fe^{2+} oxidised/Fe^{2+} changes colour **or** (catalytic) decomposition of H_2O_2 to give (H_2O and) O_2 **or** exothermic as heat is given out / temp increases	1	
		(iii)	Yellow/orange/red-orange/brown/red-brown (*not red*) with **FB 7** **and** black/blue-black/dark blue with starch	1	
			Both conclusions about **FB 7** are correct • cation – not known • anion – iodide/I^-	1	[7]
	(b)	**(i)**	Two observations for the Mg tests are correct. • Fizzing/bubbles/effervescence with **FB 8** • Black/dark grey (solid/precipitate) with **FB 9**	1	
	(b)	**(i)**	Positive gas test performed and recorded: Gas/H_2 (evolved from Mg + **FB 8**) pops with a lighted splint/when ignited/when burned *Mark may also be credited for positive O_2 test in* **3(a)(ii)**: *gas/O_2 relights glowing splint/glowing splint glows brighter.*	1	
			Remaining three observations in the table are correct • **FB 7** + **FB 8** – no reaction/no change • **FB 7** + **FB 9** – (pale) yellow precipitate • **FB 8** + **FB 9** – white precipitate	1	
		(ii)	Cation in **FB 9** is silver/Ag^+	1	

Question	Indicative material	Mark	Total
(iii)	$Ag^+ + I^- \rightarrow AgI$ (*ecf from* **FB 7**+**FB 9**: cream ppt Br^-, white ppt Cl^-) (*State symbols are not required but if given must be correct.*)	1	
(iv)	**FB 8** is hydrochloric acid / HCl (*Allow HBr from cream/off-white ppt in table with* **FB 8** + **FB 9**)	1	[6]
Qn 3		**Total**	[13]