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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

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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 $\delta \leq 0.20$ (cm^3) Award **V** and **VI** if $0.20 < \delta \leq 0.40$ Award **V**, only, if $0.40 < \delta \leq 0.80$ ***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]

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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 = $0.0250 \times \frac{\textbf{(b)}}{1000}$	1	
(ii)	**2**$KMnO_4$ + $5H_2O_2$ + $3H_2SO_4$ → K_2SO_4 + $2MnSO_4$ + **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]**

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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	

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(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 $\Delta H = -\frac{\textbf{(ii)}}{1000 \times \textbf{(iii)}}$ **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]**

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Question	Indicative material	Mark	Total
	FB 6 is $(NH_4)_2Fe(SO_4)_2$; **FB 7** is KI; **FB 8** is HC*l*; **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	

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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]**

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