Cambridge International AS & A Level

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CHEMISTRY **9701/35**

Paper 3 Advanced Practical Skills 1 **May/June 2016**

MARK SCHEME

Maximum Mark: 40

Published

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Question	Indicative material	Mark	Total
1 (a)	**I** Initial and final readings **and** titre value given for rough titre **and** initial and final readings for two (or more) accurate titrations *(minimum of 2 x 2 box)*	1	
	II Titre values recorded for accurate titrations **and** Appropriate headings for the **accurate** titration table **and** cm^3 units. • initial / start burette reading / volume / value • final / end burette and reading / volume / value • titre **or** volume / **FA2 and** used / added unit: / cm^3 **or** (cm^3) **or** in cm^3 **or** cm^3 (for each heading)	1	
	III All **accurate** burette readings recorded to the nearest 0.05 cm^3. *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 (or more) uncorrected, **accurate** titres within 0.10 cm^3 • *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 two initial 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 cm^3) are given to **zero** dp.*	1	
	V, VI and **VII** Examiner rounds any accurate burette to the nearest 0.05 cm^3, checks subtractions and then select the **'best' titres** using the hierarchy: • two (or more) accurate identical titres, *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 should be used to calculate the mean titre, expressed to nearest 0.01 cm^3. Accuracy marks are awarded as shown. Award **V**, **VI** and **VII** if $\delta \leqslant$ **0.20** cm^3 Award **V** and **VI** if **0.20** $< \delta \leqslant$ **0.40** cm^3 Award **V** only if **0.40** $< \delta \leqslant$ **0.60** cm^3	3	[7]

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Question	Indicative material	Mark	Total
(b)	Candidate must take the average of two (or more) titres that are within a total spread of not more than 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**, rounded to the nearest 0.01. Two special cases where the mean may not be to 2 dp: • Allow mean expressed to 3 dp **only** for 0.025 or 0.075 (e.g. 26.325) • Allow mean if expressed to 1 dp if **all** accurate burette readings were given to 1 dp **and** the mean is **exactly** correct. *(e.g. 26.0 and 26.2 = 26.1 is allowed)* *(e.g. 26.0 and 26.1 = 26.1 is incorrect – should be 26.05.)* ***Note:** the candidate's mean will sometimes be marked as correct even if it is different from the mean calculated by the examiner for the purpose of assessing accuracy.*	1	[1]
(c) (i)	Correctly calculates n(NaOH) used = $\frac{4.20}{40.0} \times \frac{(\mathbf{b})}{1000}$	1	
(ii)	Equation correct $2NaOH(aq) + H_2SO_4(aq) \rightarrow Na_2SO_4(aq) + 2H_2O(l)$ *State and symbols must be correct*	1	
(iii)	**and** answer **(i)** divided by 2		
(iv)	Correct use of 40 × answer **(iii)**	1	
(v)	Correct use of 25 × answer **(iv)**	1	
	All answers to 3 or 4 significant figures (minimum 3 answers attempted)	1	[5]
Question 1			**[13]**

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Question	Indicative material	Mark	Total
2 (a) (i)	Tables / lists of data in **(a)** and **(b)** • Three unambiguous headings • Unit 'covering' all temperatures • Four thermometer readings recorded • Two temperature changes recorded	1	
	Readings and subtraction in **(a)** and **(b)** • All four thermometer readings recorded to 0.0 or 0.5 °C • Both temperature changes correctly subtracted	1	
	Accuracy mark awarded as shown. *Examiner checks subtractions and compares the candidate's temperature rise with the Supervisor's. The difference is δ.* If $\delta \leqslant 1.0$ °C, award **one** mark *If $\Delta T \geqslant 20.0$ °C then award for $\delta \leqslant 2.0$ °C*	1	
(ii)	Correctly calculates energy produced in **(a)** Energy produced = $25 \times 4.2 \times$ temperature change *Answer correct to 2 to 4 significant figures.*	1	
(iii)	Correctly calculates $n(H_2SO_4) = 0.025 \times$ **1(c)(v)** *Answer must be correct to 2, 3 or 4 significant figures.*	1	
(iv)	Correct expression and negative sign Enthalpy change = $-\dfrac{\textbf{ans(ii)}}{\textbf{ans(iii)}} \times \dfrac{1}{1000}$ *Answer must be correct to 2, 3 or 4 significant figures.*	1	[6]
(b) (i)	Accuracy mark awarded as shown. *Examiner checks subtractions and compares the candidate's temperature rise with the supervisor's. The difference is* δ • If $\delta \leqslant 1.0$ °C, award **two** Q marks • If $1.0 < \delta \leqslant 2.0$ °C, award **one** Q mark	2	
(ii)	Correctly calculates energy produced in (b) • Energy produced = $25 \times 4.2 \times$ temp rise • Answer correct and expressed to 2, 3 or 4 significant figures.	1	
(iii)	Correct expression and negative sign Enthalpy change = $\dfrac{\textbf{answer(b)(ii)}}{\textbf{(a)(iii)}} \times \dfrac{1}{1000}$ *Answer must be correct to 2, 3 or 4 significant figures.*	1	[4]

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Question	Indicative material	Mark	Total
(c)	Attempt at a Hess' Law energy cycle • Two correct arrows from the equation • Left arrow labelled with **(a)(iv)** or numerical value • Right arrow labelled with **(b)(iii)** or numerical value	1	
	Correctly calculates enthalpy change Answer = **(a)(iv) – (b)(iii)**	1	[2]
(d) (i)	% error = $\frac{2 \times 0.5}{\textbf{temp rise in } (\textbf{b})} \times 100$	1	
(ii)	The student is wrong because MgO is in excess **or** The student is wrong because H_2SO_4 is the limiting reagent	1	[2]
Question 2			**[14]**

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Question	Indicative material	Mark	Total
	FA 6 is $Mg(NO_3)_2$; **FA 7** is $KI + ZnSO_4$ (= ZnI_2)		
3 (a) (i)	Observations • (On gentle heating) it melts / dissolves **or** changes to liquid • Condensation inside tube **or** steam evolved **or** fizz / bubbles • (On strong heating) white residue / solid formed • Brown gas / fumes liberated • (Moist blue) litmus turns red • Gas / oxygen relights a glowing spill (or makes it glow brighter) *5 or 6 observations correct = 3 marks* *3 or 4 observations correct = 2 marks* *1 or 2 observations correct = 1 mark*	3	
(ii)	Observations in first two tests • With H_2SO_4 – no reaction / no change • With ammonia – white precipitate, insoluble / no change in excess • With cold NaOH - white precipitate **and** no change / insoluble excess	1 1	
	Subsequent observations • Ignore observation on heating alone unless a gas is identified **or** litmus turns blue • When A*l* is added, gas / NH_3 turns litmus blue	1	
(iii)	Conclusion **FA 6** is $Mg(NO_3)_2$	1	
	$Mg^{2+}(aq) + 2OH^-(aq) \rightarrow Mg(OH)_2(s)$	1	[8]
(b) (i)	Observation with NaOH White precipitate (forms) **and** soluble in excess (NaOH)	1	
	Observation with NH_3 White precipitate (forms) **and** soluble in excess (NH_3)	1	
	Both observations required • Brown / orange / red-brown / yellow / yellow-brown (solution) formed **and** • Goes dark blue/black/blue-black when starch added	1	
(ii)	Conclusion **FA 7** is zinc iodide / ZnI_2	1	
	Correct test and result • Add silver nitrate • Yellow precipitate formed	1	[5]
Question 3			**[13]**

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