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CHEMISTRY **9701/32**

Paper 3 (Advanced Practical Skills 2) **May/June 2017**

MARK SCHEME

Maximum Mark: 40

Published

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Question	Answer	Marks
1(a)	**I** Initial and final burette readings and volume added recorded for rough titre **and** accurate titre details tabulated. [minimum 2 × 2 'boxes' with relevant information]	**1**
	II Initial and final burette readings recorded and volume of **FB 2** added recorded for each accurate titration. Headings and units correct for accurate titrations Headings: initial / final (burette) reading / volume **or** reading / volume at start / finish **and** volume / **FB 2** added/used **or** titre **and** Units: (cm^3) **or** / cm^3 **or** in cm^3 [or cm^3 by every entry]	**1**
	III All accurate burette readings are 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 The **final** accurate titre recorded is within 0.10 cm^3 of any other accurate titre.	**1**

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Question	Answer	Marks
1(a)	**For assessment of accuracy (Q) marks,** each Examiner should round any accurate burette readings to the nearest 0.05 cm^3, check subtractions and then select the "best" titres for supervisor and candidate using the hierarchy: *two identical; titres within 0.05 cm^3; titres within 0.1 cm^3; etc.* These best titres should be used to calculate the mean titre, expressed to the nearest 0.01 cm^3. The candidate's titre is compared to the supervisor's titre and δ calculated.	
	V, VI and **VII** Award **V**, **VI** and **VII** for $\delta \leqslant 0.20\ cm^3$ Award **V** and **VI** for $0.20\ cm^3 < \delta \leqslant 0.30\ cm^3$ Award **V** for $0.30\ cm^3 < \delta \leqslant 0.50\ cm^3$	**3**
1(b)	Check mean titre is correctly calculated from clearly selected values (ticks or working). • Candidate must average two (or more) titres where the total spread is $\leqslant 0.20\ cm^3$. • Working must be shown or ticks must be put next to the two (or more) accurate readings selected. • The mean should normally be quoted to 2 dp rounded to the nearest 0.01. [*e.g. 26.667 must be rounded to 26.67*] Two special cases where the mean may not be to 2 dp: allow mean to 3 dp only for 0.025 or 0.075 e.g. 26.325; allow mean 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 correct* *but 26.0 and 26.1 = 26.1 is incorrect*.] Do **not** award this mark if: • the rough titre was used to calculate the mean; • candidate carried out only 1 accurate titration; • burette readings were incorrectly subtracted to obtain any of the accurate titre values; • **all** burette readings (resulting in titre values used in calculation of mean) are integers. *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 $\frac{0.100 \times 25}{1000} = 2.5(0) \times 10^{-3}$	**1**

Question	Answer	Marks
1(c)(ii)	Correctly calculates $\frac{0.0025 \times 1000}{(\mathbf{b})}$ to 3 or 4 sf	**1**
1(c)(iii)	Correct expression 12.6 ÷ **(ii)**	**1**
1(c)(iv)	Anion in **FB 1** = $CHCl_2COO^-$ (allow ecf: for candidate's answer to **(iii)**) CH_3COO^- : ⩽ 77 CH_2ClCOO^- : 77.5 – 111.5 $CHCl_2COO^-$: 112 – 146 CCl_3COO^- : ⩾ 146.5	**1**
1(d)(i)	Conc NaOH lower = > titre smaller = > smaller M_r	**1**
1(d)(ii)	No effect on identification unless closer to smaller mass acid **or** (different M_r may lead to the) identification of a different acid with matching / close to M_r	**1**
	Total:	**14**

Question	Answer	Marks
2(a)	**I** Unambiguous headings and correct units tabulated for all 6 thermometer readings, mean temps, and ΔTs	**1**
	II All thermometer readings recorded to 0.5 °C **and** ΔTs correctly calculated **and** Mean temperatures correctly calculated to nearest .5 °C or to 1 or 2 dp	**1**
	Award **III** if candidate ΔTs within 1.5 °C	**1**
	Award **III** and **IV** if candidate ΔTs within 1.0 °C	**1**
2(b)(i)	Correctly calculates n acid = 0.05(0) mol **and** n NaOH = 0.045 mol	**1**

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Question	Answer	Marks
2(b)(ii)	Correctly calculates $50 \times 4.2 \times \Delta T_1$ to minimum 2 sf	**1**
2(b)(iii)	Correct expression $\frac{(\textbf{ii})}{1000 \times 0.045}$	**1**
2(b)(iv) +(v)	$2 \times$ mol NaOH in **(i)** or 0.09(0) in (iv) **and** Correctly uses $\frac{100 \times 4.2 \times \Delta T(2)}{1000 \times (\textbf{iv})}$ in **(v)**	**1**
	Negative signs shown in **(iii)** and **(v)** and final answers to 2–4 sf in **(ii)**, **(iii)** & **(v)**	**1**
2(c)(i)	% error in vol of **FB 3** = $\frac{0.5 \times 100}{50}$ = 1.(0)%	**1**
	% error in vol of **FB 4** = $\frac{2 \times 0.25 \times 100}{25}$ = 2.(0)%	**1**
2(c)(ii)	Use a burette / pipette for volume measurements / instead of a measuring cylinder **or** Add a lid to reduce **heat loss** (by convection) / to reduce convection **or** Use thermometer reading to 0.2 °C / smaller divisions / calibrations / more sensitive	**1**
	Total	**12**

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Question	Answer	Marks
	FB 5 is CH_3COOH; **FB 6** is HC*l*; **FB 7** is HNO_3; **FB 8** is $CuSO_4(aq)$; **FB 9** is Na_2edta	
3(a)(i)	Selects Na_2CO_3 / Mg	**1**
	Effervescence / bubbling / fizzing greater / faster with **FB 6**	**1**
	FB 5 is the weak acid (ora) with some evidence	**1**
3(a)(ii)	no reaction / no ppt / no change with Ag^+ **and** 'not needed' with Ba^{2+} (do not allow 'no change' unless there is no evidence of ammonia in 2nd test) Effervescence alone is not evidence so would expect 'no change'.	**1**
	Effervescence / gas / NH_3 **and** turns (damp red) litmus blue	**1**
	FB 7 is nitric acid from some evidence (can be effervescence in (ii))	**1**

Question	Answer	Marks
3(b) (i) – (vi)	**See below**	**6**

Expected observations

test	*observation*	*mark*
(i) + Na_2CO_3	(pale) blue ppt (Allow blue-green / green-blue / turquoise / cyan)	**1**
(ii) + KI then	Yellow-brown / brown (not orange)	**1**
$Na_2S_2O_3$	white / off-white ppt **and** soluble in excess	**1**
(iii) + c.HC*l* **and**	(blue) (solution) turns green (shade greener)	
(iv) + H_2O	(green) (solution) turns (pale) blue (shade bluer)	**1**
(v) + NH_3	(in excess) forming dark/deep blue **solution** **or solution** much darker than **(iv)**	**1**
(vi) + edta	(solution) more blue / darker blue than **(iv)**	**1**

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Question	Answer	Marks
3(vii)	**FB 8** contains Cu^{2+}/copper(II)	**1**
3(viii)	$Cu^{2+}(aq) + CO_3^{2-}(aq) \rightarrow CuCO_3(s)$ Allow $2Cu^{2+}(aq) + 4I^-(aq) \rightarrow 2CuI(s) + I_2$(aq or s) Allow $Cu^{2+}(aq) + 2OH^-(aq) \rightarrow Cu(OH)_2(s)$	**1**
	Total:	**14**

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Mark allocation

Skill	***Minimum mark allocation***	Breakdown of marks	***Statement***	Minimum Marks	***Question 1***	***Question 2***	***Question 3***	***Total mark***
Manipulation, measurement and observation (MMO)	12 marks **[17]**	Successful collection of data and observations	C	**8**	1		9	**10**
		Quality of measurements and observations	Q	**2**	3	2		**5**
		Decisions relating to measurements of observations	De	**2**	1		1	**2**
Presentation of data and observations (PDO)	6 marks **[7]**	Recording data or observations	R	**2**	1	1		**2**
		Display of calculation and reasoning	Di	**2**	1	2		**3**
		Data layout	L	**2**	1	1		**2**
Analysis, conclusions and evaluation (ACE)	10 marks **[16]**	*Interpretation of data or observations and identifying sources of error*	I	**4**	3	5	1	**9**
		Drawing conclusions	Con	**5**	3		3	**6**
		Suggesting improvements	Imp	**1**		1		**1**
Total					**14**	**12**	**14**	**40**

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