
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)	<p>For assessment of accuracy (Q) marks, each Examiner should round any accurate burette readings to the nearest 0.05 cm³, check subtractions and then select the “best” titres for supervisor and candidate using the hierarchy: <i>two identical; titres within 0.05 cm³; titres within 0.1 cm³; etc.</i></p> <p>These best titres should be used to calculate the mean titre, expressed to the nearest 0.01 cm³.</p> <p>The candidate’s titre is compared to the supervisor’s titre and δ calculated.</p> <p>V, VI and VII Award V, VI and VII for $\delta \leq 0.20 \text{ cm}^3$ Award V and VI for $0.20 \text{ cm}^3 < \delta \leq 0.30 \text{ cm}^3$ Award V for $0.30 \text{ cm}^3 < \delta \leq 0.50 \text{ cm}^3$</p>	3
1(b)	<p>Check mean titre is correctly calculated from clearly selected values (ticks or working).</p> <ul style="list-style-type: none"> • Candidate must average two (or more) titres where the total spread is $\leq 0.20 \text{ cm}^3$. • 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. <p>[e.g. 26.667 must be rounded to 26.67]</p> <p>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.]</p> <p>Do not award this mark if:</p> <ul style="list-style-type: none"> • 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. <p><i>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.</i></p>	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 $\frac{0.0025 \times 1000}{(b)}$ to 3 or 4 sf	1
1(c)(iii)	Correct expression $12.6 \div (ii)$	1
1(c)(iv)	Anion in FB 1 = $\text{CHCl}_2\text{COO}^-$ (allow ecf: for candidate's answer to (iii)) $\text{CH}_3\text{COO}^- : \leq 77$ $\text{CH}_2\text{ClCOO}^- : 77.5 - 111.5$ $\text{CHCl}_2\text{COO}^- : 112 - 146$ $\text{CCl}_3\text{COO}^- : \geq 146.5$	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 ΔT s	1
	II All thermometer readings recorded to 0.5 °C and ΔT s correctly calculated and Mean temperatures correctly calculated to nearest .5 °C or to 1 or 2 dp	1
	Award III if candidate ΔT s within 1.5 °C	1
	Award III and IV if candidate ΔT s 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 $\frac{\text{(ii)}}{1000 \times 0.045}$	1
2(b)(iv) +(v)	$2 \times \text{mol NaOH}$ in (i) or 0.09(0) in (iv) and Correctly uses $\frac{100 \times 4.2 \times \Delta T(2)}{1000 \times \text{(iv)}}$ 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 ₃ COOH; FB 6 is HCl; FB 7 is HNO ₃ ; FB 8 is CuSO ₄ (aq); FB 9 is Na ₂ edta		
3(a)(i)	Selects Na ₂ CO 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

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

Expected observations

test	observation	mark
(i) + Na ₂ CO ₃	(pale) blue ppt (Allow blue-green / green-blue / turquoise / cyan)	1
(ii) + KI then	Yellow-brown / brown (not orange)	1
Na ₂ S ₂ O ₃	white / off-white ppt and soluble in excess	1
(iii) + c.HCl and	(blue) (solution) turns green (shade greener)	
(iv) + H ₂ O	(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)	$\text{Cu}^{2+}(\text{aq}) + \text{CO}_3^{2-}(\text{aq}) \rightarrow \text{CuCO}_3(\text{s})$ Allow $2\text{Cu}^{2+}(\text{aq}) + 4\text{I}^{-}(\text{aq}) \rightarrow 2\text{CuI}(\text{s}) + \text{I}_2(\text{aq or s})$ Allow $\text{Cu}^{2+}(\text{aq}) + 2\text{OH}^{-}(\text{aq}) \rightarrow 2\text{Cu}(\text{OH})_2(\text{s})$	1
	Total:	14

Mark allocation

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