

MARK SCHEME for the May/June 2012 question paper for the guidance of teachers

9701 CHEMISTRY

9701/34

Paper 32 (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.

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International Examinations

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Question	Sections	Indicative material	Mark	Total
1 (a)	MMO Collection PDO Layout	<p>I Two rough titres recorded.</p> <p>II Single table for each titration (step 1 and 2) <i>Minimum of 2 × 2 “boxes”</i></p>	1 1	
	PDO Recording	<p>III Initial and final burette readings unambiguously recorded for rough and accurate titrations carried out.</p> <p>IV Correct headings and units in both titration tables. <i>Acceptable headings:</i> <i>initial/final or 1st/2nd (burette)</i> <i>(reading)/(volume)//(reading at)/(volume at)</i> <i>start/finish; volume added/used/titre; or wtte,</i> not difference, total volume or volume FB 1 <i>Acceptable units are solidus: /cm³; brackets: (cm³);</i> <i>in words: volume in cubic centimetres, volume in cm³.</i> If units are not included in the heading every entry in the table must have the correct unit.</p>	1 1	
	MMO Collection	<p>V All accurate burette readings to 0.05 cm³ <i>Do not award this mark if:</i> <i>50.(00) is used as an initial burette reading;</i> <i>more than one final burette reading is 50.(00);</i> <i>any burette reading is greater than 50.(00)</i></p>	1	
	Decisions	<p>VI Two burette readings within 0.10 cm³ in each titration step. <i>Do not allow the Rough even if ticked.</i> <i>Do not award this mark if having performed two titres within 0.1 cm³ a further titration is performed which is more than 0.10 cm³ from the closer of the initial two titres, unless a fourth titration, within 0.1 cm³ of any other has also been carried out.</i> <i>Mark not awarded if any accurate reading is given to zero dp apart from initial '0'.</i></p>	1	
		Step 1: Examiner subtracts candidate's titre (corrected to 0.01 cm ³) from supervisor's titre		
	MMO Quality	<p>Award VII, VIII, IX if $\delta \leq 0.1 \text{ cm}^3$</p> <p>Award VII, VIII if $0.10 < \delta \leq 0.20 \text{ cm}^3$</p> <p>Award VII if $0.20 < \delta \leq 0.40 \text{ cm}^3$</p> <p>If Supervisor's titre < 10.00 cm³ then halve the tolerances</p> <p>Spread penalty (see below)</p>	1 1 1	
		Step 2: Examiner subtracts (corrected) candidate's titre from supervisor's titre. Check and correct titre as above.		

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Question	Sections	Indicative material	Mark	Total
1 (a) cont.	MMO Quality	<p>Award X, XI, XII if $\delta \leq 0.20 \text{ cm}^3$</p> <p>Award X, XI if $0.20 < \delta \leq 0.40 \text{ cm}^3$</p> <p>Award X only if $0.40 < \delta \leq 0.80 \text{ cm}^3$</p> <p>If Supervisor's titre < 10.00 cm^3 then halve the tolerances</p> <p><i>Apply spread penalty to each of steps 1 and 2 as follows:</i></p> <p><i>titres selected (by examiner) differ by $> 0.50 \text{ cm}^3 = -1$;</i></p> <p><i>Apply a spread penalty of -1 if only one accurate titration is performed.</i></p>	1 1 1	[12]
(b)	ACE Conclusion Interpret- ation	<p>(i) Check mean titre correctly calculated from clearly selected values (ticks or working)</p> <p>(ii) $\text{C}_2\text{O}_4\text{H}_2 + 2\text{NaOH} \rightarrow \text{C}_2\text{O}_4\text{Na}_2 + 2\text{H}_2\text{O}$</p> <p>(iii) Correctly calculate $\{(b)(i) \times 0.10\}/1000$ and</p> <p>(iv) (iii)/2 (ecf from equation)</p>	1 1	[2]

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Question	Sections	Indicative material	Mark	Total
(c)	ACE Interpretation	<p>I (i) Calculation of mean for (b)(i) and (c)(i) Candidate must average two (or more) titres that are within 0.20 cm^3 of each other. Working must be shown or ticks must be put next to the two (or more) accurate readings selected. <i>The mean should normally be quoted to 2 dp rounded to the nearest 0.01. Example: 26.667 must be rounded to 26.67.</i> <i>Two special cases where the mean may not be to 2 dp:</i> <i>allow mean to 3 dp only for 0.025 or 0.075 e.g. 26.325;</i> <i>allow mean to 1 dp if all accurate burette readings were given to 1 or zero 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.</i> Do not award this mark if: <i>any selected titre is not within 0.20 cm^3 of any other selected titre unless a spread penalty has been applied or two pairs of accurate titres shown (e.g. 21.1, 21.2, 21.4, 21.5 should have a mean of 21.3);</i> <i>the rough titre was used to calculate the mean;</i> <i>the candidate carried out only 1 accurate titration in both steps 1 and 2;</i> <i>burette readings were incorrectly subtracted to obtain any of the accurate titre values.</i> <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	
	PDO Display	<p>II Correctly calculates (ii) (c)(i) $\times 0.02/1000$ and (iii) (c)(ii) $\times 5/2$</p> <p>III (iv) Expression (c)(iii) – (b)(iv)</p> <p>IV Working in the correct direction is shown in any 4 steps of (b)(iii) and (iv), (c)(ii), (iii) and (iv)</p>	1 1 1	[4]

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Question	Sections	Indicative material	Mark	Total
(d)	ACE Interpretation	<p>I Correct M_r in both (i) 90(.0) and (ii) 134(.0) Allow ecf from misprint in (ii) of 102(.0)</p> <p>II Correct calculation of (i) $C_2O_4H_2 = (b)(iv) \times 90.0$ (allow ecf) and (ii) $C_2O_4Na_2 = (c)(iv) \times 134.0$ (allow ecf) [Default values: (i) 0.05859/0.0586; (ii) 0.05534/0.0553 or 0.04213/0.0421]</p> <p>If one of (d)(i) or (d)(ii) is fully correct then one mark may be awarded. i.e. mark horizontally or vertically</p>	1	
	Conclusion	<p>III (iii) Expression {mass $C_2O_4Na_2$ in (ii)/total mass} $\times 100$ [total mass = (d)(i) + (d)(ii)] If $\times 100$ missing from expression then correct % needed</p>	1	
	PDO Display	<p>IV Final answer to each step attempted of (b)(ii), (iv), (c)(ii), (iii),(iv) and (d)(i), (ii), (iii) to 3 or 4 sf (minimum 5 steps)</p>	1	[4]
(e)	ACE Interpretation	<p>(i) $(\pm)0.05 \text{ cm}^3$</p> <p>(ii) (i) $\times 2$ (ecf) so burette less accurate/ student incorrect use of $\{0.10/25\} \times 100$ or $(\pm)0.06$ compared with $(\pm)0.10$</p>	1 1	[2]
(f)	ACE Improvement	No improvement as acid in excess	1	[1]
[Total: 25]				

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Question	Sections	Indicative material	Mark	Total
FB 5 = NaNO₂; FB 6 = NH₄Cl; FB 7 = NaNO₃; FB 8 = NiSO₄(aq); FB 9 = FeSO₄(aq)				
2 (a)	MMO Collection	<p>I (i) effervescence/bubbling/fizzing and either brown gas or blue solution</p> <p>II (ii) (colourless) solution (turns) yellow/orange/red-brown/brown or forms black/dark grey ppt/solid</p> <p>III (iii) (purple) solution/KMnO₄ turns colourless/blue or solution remains colourless/turns blue</p> <p>IV (iv) solid sublimes//solid/ppt reforms (on cooler part of tube)//white solid/ppt further up tube</p> <p>V (v) gas/NH₃ turns (damp) red litmus blue and no reaction in (vii) (ignore bubbling/ etc. on heating) (If gas not tested in (v) but is in (iv) then mark may be awarded provided NH₃ appears in (v))</p> <p>VI (vi) gas relights glowing splint or solid melts/dissolves/forms solution and pale yellow/white/cream/off-white solid/ppt forms on cooling</p>	1 1 1 1 1 1	[6]
(b)	ACE Conclusion	<p>(i) N from single correct obs [brown gas (i)(ii)(iii)/blue solution (i)(iii)/NH₃ (iv)(v)/O₂ (vi)] (allow N₂)</p> <p>(ii) FB 5 +3 FB 6 -3</p> <p>(iii) redox/oxidation and reduction//oxidation of N/NO₂⁻//reduction of Mn/MnO₄⁻</p>	1 1 1	[3]

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Question	Sections	Indicative material	Mark	Total
(c)	MMO Decisions	I (i) NaOH and NH ₃ Allow KMnO ₄ and/or K ₂ Cr ₂ O ₇	1	
	PDO Layout	II (ii) Tabulated with no repeated headings <i>Allow from incorrect reagents but do not award if extra reagent introduced.</i>	1	
	MMO Collection	III Both give green ppt with NaOH. FB 8 blue solution with NH ₃ (not dark blue) FB 9 green ppt with NH ₃ FB 8 no change/no reaction with KMnO ₄ and K ₂ Cr ₂ O ₇ FB 9 (KMnO ₄) turns yellow/decolourised/yellow-brown/orange; (K ₂ Cr ₂ O ₇) turns green/yellow-green <i>Allow Fe(OH)₂ ppt as dirty or dark green</i>	1	
	ACE Conclusion	IV (iii) Fe ²⁺ = FB 9 from green/etc. ppt insol in excess NH ₃ (ora) (= 2 obs) or green/etc. ppt turning brown in NH ₃ (= 2 obs) green/etc. ppt with NH ₃ (= 1 obs) (positive MnO ₄ ⁻ = 1 obs) (positive Cr ₂ O ₇ ²⁻ = 1 obs) Evidence must match observations in (ii)	1	
		V (iv) (green) solution/turns blue (Ni ²⁺) <i>allow towards blue e.g. cyan</i> If Fe ²⁺ = FB 8 in (iii) then ecf obs: solution/turns (pale) yellow/no reaction/no change	1	
	MMO Collection	VI (v) (purple)/KMnO ₄ turns yellow/decolourised/yellow-brown/orange	1	[6]
[Total: 15]				