## MARK SCHEME for the May/June 2011 question paper

## for the guidance of teachers

## 9701 CHEMISTRY

9701/32

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.

Mark schemes must be read in conjunction with the question papers and the report on the examination.

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Page 2	Mark Scheme: Teachers' version	Syllabus	Paper
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Question	Sections	Indicative material	Mark	
1 (a)	PDO Layout	<ul> <li>Volume given for Rough titre and accurate titre details tabulated. <i>Minimum of 2 × 2 boxes.</i></li> </ul>	1	
	MMO Collection	<ul> <li>Initial and final (burette) (readings) and volume of FB 2 added/reading at start and finish recorded for each accurate titre (not 'difference').</li> <li>and mass tube + FB 1, mass tube + residue/empty, mass FB 1.</li> <li>Ignore units.</li> <li>Headings should match readings.</li> <li>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).</li> </ul>	1	
	PDO Recording	<ul> <li>All accurate burette readings (initial and final) recorded to nearest 0.05 (cm<sup>3</sup>).</li> <li>Assessed on burette readings only (minimum of 2 readings).</li> </ul>	1	
	MMO Decisions	IV Has two uncorrected accurate titres within 0.1 cm <sup>3</sup> . Do not award this mark if, having performed two titres within 0.1 cm <sup>3</sup> , a further titration is performed that is more than 0.10 cm <sup>3</sup> from the closer of the initial two titres, unless a fourth titre, within 0.1 cm <sup>3</sup> of any of the previous titres, has also been carried out.	1	
Check and of mass. Examiner two identic	d correct, if necess then selects the 'b cal; titres within 0.0	to the nearest 0.05 cm <sup>3</sup> . ary, subtractions in the titre table and in the calculation est' titre using the hierarchy: 05 cm <sup>3</sup> , titres within 0.1 cm <sup>3</sup> etc.		
Calculate:	candidate's titre ×	Supervisor mass candidate mass to 2 decimal places		
Calculate marks as t		rvisor and candidate scaled values and award quality		
	MMO Quality	<b>V</b> , <b>VI</b> and <b>VII</b> Award <b>V</b> , <b>VI</b> and <b>VII</b> if $\delta \le 0.25 \text{ cm}^3$	3	
		Award <b>V</b> and <b>VI</b> if $0.25 < \delta \le 0.50 \text{ cm}^3$		
		Award <b>V</b> if $0.50 < \delta \le 0.80  \text{cm}^3$		
		If the 'best' titres are $\geq 0.60 \text{ cm}^3$ apart cancel one of the Q marks.		[7]

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(b)	ACE Interpretation	Calculates the mean, correct to 2 decimal places from any <b>accurate</b> titres within 0.2 cm <sup>3</sup> .	1	
		The third decimal place may be rounded to the nearest $0.05 \text{ cm}^3$ . A mean of exactly .×25 or .×75 is allowed but the candidate may round up to .×3 or .×8 or to the nearest $0.05 \text{ cm}^3$ . If ALL burette readings are given to 1 decimal place then the mean can be given to 1 decimal place if numerically correct without rounding, Mean of 24.3 and 24.4 = 24.35 ( $\checkmark$ ) Mean of 24.3 and 24.4 = 24.4 ( $\times$ )		
		Titres to be used in calculating the mean must be clearly shown – in an expression or ticked in the titration table.		
		Allow ecf from subtraction error for titre.		[1]
(c)	ACE Interpretation	<ul> <li>I Correctly evaluates step (i) (= mean titre × 0.2 / 1000)</li> <li>II, III and IV are awarded for the correct expression or for the correct answer if no working shown.</li> <li>For all 'method' marks, no additional steps can be included.</li> </ul>	1	
		II Step (ii) (answer to (i) / 2) and step (iii) (answer to (ii) × 10)	1	
		<ul> <li>III In (iv) relative formula mass</li> <li>(= mass of washing soda / answer to (iii))</li> <li>(ignore g)</li> </ul>	1	
		IV In (v) answer to (iv) – 106 / 18 or 106 + 18x = answer to (iv) (mark method even if M <sub>r</sub> is < 106 or very large).	1	
	PDO Display	<ul> <li>V Some relevant working shown in a minimum of four parts in the calculation (in (ii) could be × 2 or ÷ 2, in (iii) could be × 10 or ÷ 10, in (v) could be use of 106).</li> </ul>	1	
		<ul> <li>VI In steps (i) to (iv) all answers to 3 or 4 sig figs (minimum of 3 steps).</li> </ul>	1	[6]
(d)	ACE Interpretation	0.1 × 100 / titre from <b>(b)</b> (only expression needed).	1	[1]
			[To	tal: 15]

2       (a)       PDO Layout       I         PDO Recording       II       II         PDO Recording       III         PDO Recording       III         Round all thermometer readings to negotiate to 1 decimal place: candidate candidate and marks as below.       III         Calculate to 1 decimal place: candidate and marks as below.       IV and Awa Supplementation         (b)       (i)       ACE Interpretation       I         (iii)       ACE Interpretation       I       I         (iii)       III       I       I         (iii)       III       I       I         (iii)       III       III       III	the temperature change × $\frac{\text{Supervisor mass}}{\text{candidate mass used}}$ Supervisor scaled values and award quality and <b>V</b> and <b>IV</b> and <b>V</b> for changes within 0.8°C of ervisor ard <b>V</b> for changes > 0.8 but within 1.6°C of	ז 1	
PDO Recording       II         PDO Recording       III         PDO Recording       III         PDO Recording       III         Round all thermometer readings to negotiate subtractions in the temperature change       Calculate to 1 decimal place: candidate         Calculate difference in candidate and marks as below.       IV at a super candidate         (b) (i)       ACE         (ii)       ACE         (iii)       II         (iii)       II	thermometer readings and one change in temperature shown in suitable layout. Masses and temperatures recorded with correct headings and units for all data shown. Acceptable units for temperature are /°C, (°C), temperature in degrees Celsius, temperature in °C., units for mass are /g, (g), mass in grams. All thermometer readings recorded to $0.0$ °C or 0.5 °C and all balance readings recorded to $0.0$ °C or 0.5 °C and all balance readings recorded to same degree of accuracy. earest $0.5$ °C.Check and correct, if necessary, ge and the mass used. ate temperature change × Supervisor mass candidate mass used Supervisor scaled values and award quality and V and V for changes within $0.8$ °C of ervisor ard V for changes > 0.8 but within $1.6$ °C of	ct 1 7 1	
PDO Recording       III         Round all thermometer readings to negotiate subtractions in the temperature change         Calculate to 1 decimal place: candidate and marks as below.         MMO Quality       IV and Awa Supplementation         (b) (i)       ACE Interpretation       I         (iii)       III       I         (iii)       III       I	headings and units for all data shown. Acceptable units for temperature are /°C, (°C), temperature in degrees Celsius, temperature in °C., units for mass are /g, (g), mass in grams. All thermometer readings recorded to 0.0 °C or 0.5 °C and all balance readings recorded to same degree of accuracy. earest 0.5 °C.Check and correct, if necessary, ge and the mass used. ate temperature change × Supervisor mass candidate mass used Supervisor scaled values and award quality nd V and IV and V for changes within 0.8 °C of ervisor ard IV for changes > 0.8 but within 1.6 °C of	7 1	
Round all thermometer readings to negative subtractions in the temperature change         Calculate to 1 decimal place: candidate         Calculate difference in candidate and marks as below.         MMO Quality       IV and Awa Super Awa	0.5°C and all balance readings recorded to same degree of accuracy. earest 0.5°C.Check and correct, if necessary, ge and the mass used. ate temperature change × Supervisor mass candidate mass used Supervisor scaled values and award quality nd V and IV and V for changes within 0.8°C of ervisor ard IV and V for changes > 0.8 but within 1.6°C of		
subtractions in the temperature changes Calculate to 1 decimal place: candidates Calculate difference in candidate and marks as below. MMO Quality IV and Awa Support (b) (i) ACE I Interpretation II	ge and the mass used. ate temperature change × Supervisor mass candidate mass used Supervisor scaled values and award quality and V and IV and V for changes within 0.8°C of ervisor ard IV for changes > 0.8 but within 1.6°C of		
Calculate to 1 decimal place: candidate and marks as below.          MMO Quality       IV and Awa Super A	the temperature change × $\frac{\text{Supervisor mass}}{\text{candidate mass used}}$ Supervisor scaled values and award quality and <b>V</b> and <b>IV</b> and <b>V</b> for changes within 0.8°C of ervisor ard <b>V</b> for changes > 0.8 but within 1.6°C of		
(ii) ACE I Interpretation II	rd <b>IV</b> and <b>V</b> for changes within 0.8°C of ervisor rd <b>V</b> for changes > 0.8 but within 1.6°C of	2	
(ii) ACE I Interpretation II	ervisor rd <b>V</b> for changes > 0.8 but within 1.6°C of	2	
(b) (i) ACE I Interpretation II (ii) II II			[5
(iii)	Expression for heat change in <b>(i)</b> = 25 × 4.3 × temperature change from <b>(a)</b> (answer given must correspond to units quoted	). 1	
	Expression for moles of washing soda from ma used and M <sub>r</sub> from <b>(a)</b> or M <sub>r</sub> = 259 or Mr = 286 ir <b>(ii)</b>	1	
	Correctly evaluates enthalpy change = heat change / (1000 × moles of washing soda) in <b>(ii</b> i (if 1000 not used, must say J).		
Conclusions	Enthalpy change shown as positive and to 3 signifies. (Answer need not be arithmetically correcting and to 1 signore sig figs (except if approximated to 1 signing rest of question.)	t).	[4
Improvements more to 0. digit or use	a more precise thermometer/a thermometer w e accurate calibrations/a thermometer that read 1°C or 0.2°C (a more accurate thermometer/a al thermometer/thermocouple is insufficient) a more precise method to measure the volume	ds	
of ac or use or	cid a deeper plastic cup		
	ing up apparatus and quantities of chemicals us	ed	
(Do	not accept 'add a lid')		[1 al: 10

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FB	<b>5</b> is MgS	SO <sub>4</sub> (aq); <b>FB 6</b> is Pl	o(NO <sub>3</sub> ) <sub>2</sub> (aq) <b>FB 7</b> is Al <sub>2</sub> (SO <sub>4</sub> ) <sub>3</sub> (aq); <b>FB 8</b> is (NH <sub>4</sub> ) <sub>2</sub> FeSO	D <sub>4</sub> (aq)	
3	(a) (i)	MMO Decisions	I Reagents chosen KI(aq) or HC <i>l</i> (aq) or K <sub>2</sub> CrO <sub>4</sub> or K <sub>2</sub> Cr <sub>2</sub> O <sub>7</sub> or H <sub>2</sub> SO <sub>4</sub> and NaOH (aq) (penalise additional reagents)	1	
		MMO Collection	II NaOH white precipitates for all	1	
			III Excess NaOH no effect FB 5, precipitate dissolves FB 6 and FB 7	1	
			IV KI / HCl / K <sub>2</sub> CrO <sub>4</sub> / K <sub>2</sub> Cr <sub>2</sub> O <sub>7</sub> / H <sub>2</sub> SO <sub>4</sub> nothing/no visible reaction for (FB 5 and FB 7), yellow precipitate/white precipitate for FB 6.	1	
			Ignore observations for additional reagents.		[4]
	(ii)	ACE Conclusions	<ul> <li>FB 5 contains Mg<sup>2+</sup>, FB 6 contains Pb<sup>2+</sup> and FB 7 contains Al<sup>3+</sup> (no ecf and must follow observations in (i))</li> </ul>	1	
			II FB 5 (white) precipitate with NaOH, insoluble in excess	1	
			III FB 6 (yellow) precipitate with KI / (yellow) precipitate with K <sub>2</sub> CrO <sub>4</sub> or K <sub>2</sub> Cr <sub>2</sub> O <sub>7</sub> / (white) precipitate with HC <i>l</i> or H <sub>2</sub> SO <sub>4</sub> .	1	
			<b>FB 7</b> No precipitate with KI / $HCl / H_2SO_4$ and (white) precipitate with NaOH, soluble in excess. (Both observations needed unless <b>FB 6</b> already identified as Pb <sup>2+</sup> ).	1	
			Allow ecf, based on candidate's observations, for II, III and IV.		[4]

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(b) (i)	MMO Collection	Effervescence/bubbles/hydrogen produced (ignore any test for ammonia but tests for other gases negate). (Do not accept gas produced) or Black/grey solid/coating on magnesium	1	
(ii)		Ammonia/gas turns litmus paper blue	1	
(iii)		Green precipitate (any qualified green including grey/green but do not allow green/brown.)	1	
		Turns brown (any qualified brown) on addition of hydrogen peroxide. Allow rusty or orange/brown precipitate but not orange alone. Ignore effervescence.	1	
		Fe <sup>2+</sup> / iron (II).	1	[5]
	ACE	(+)2 to 0 (ecf on chromium (+)3 to 0) or (+)3 to (+)2).	1	
	Conclusions	(+)2 to (+)3.	1	
		Conclusions are free standing but must be Fe <sup>2+.</sup>		[2]
			[Tot	al: 15]