

UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
GCE Advanced Subsidiary Level and GCE Advanced Level

MARK SCHEME for the May/June 2011 question paper
for the guidance of teachers

9701 CHEMISTRY

9701/31

Paper 31 (Advanced Practical Skills 1),
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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Question	Sections	Indicative material	Mark	
1 (a)	PDO Layout	I Volume given for rough titre and accurate titre details tabulated. <i>Minimum of 2 × 2 boxes.</i>	1	
	MMO Collection	II Initial and final burette readings recorded for rough titre and initial and final burette readings and volume of FA 2 added recorded for each accurate titre. <i>Headings should match readings. 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)</i>	1	
	PDO Recording	III All accurate burette readings (initial and final) recorded to nearest 0.05 (cm ³) <i>Assessed on burette readings only.</i>	1	
		IV Has two uncorrected, accurate titres within 0.1 cm ³ <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 of the previous titres has also been carried out.</i>	1	
Round any burette readings to the nearest 0.05 cm ³ . Check and correct subtractions in the titre table. Examiner then selects the “best” titre using the hierarchy: two identical; titres within 0.05 cm ³ ; titres within 0.1 cm ³ ; etc				
	MMO Quality	V, VI and VII Award V, VI and VII for a difference from Supervisor within 0.20 cm ³ Award V and VI for a difference of > 0.20 – ≤ 0.40 cm ³ Award V for a difference of > 0.40 – ≤ 0.60 cm ³ <i>If the “best” titres are ≥ 0.60 cm³ apart cancel one of the Q marks.</i>	3	[7]

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(b)	ACE Interpretation	<p>Calculates the mean, correct to 2 decimal places from any accurate titres within 0.20 cm^3. <i>The third decimal place may be rounded to the nearest 0.05 cm^3.</i> <i>A mean of exactly .x25 or .x75 is allowed but the candidate may round up or down to the nearest 0.05 cm^3.</i></p> <p><i>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.</i> <i>Mean of 24.3 and 24.4 = 24.35 (✓)</i> <i>Mean of 24.3 and 24.4 = 24.4 (✗)</i></p> <p>Titres to be used in calculating the mean must be clearly shown – in an expression or ticked in the titration table.</p>	1	[1]
(c)	ACE Interpretation	<p>I Expression needed in step (i) (= mean titre $\times 0.15 / 1000$ mol) and step (ii) (= answer to step (i) / 2) <i>No irrelevant or incorrect working should be included.</i></p>	1	[4]
		<p>II Correctly evaluates step (iii) (= answer to step (ii) $\times 10$) and step (iv) (= answer to step (iii) $\times 40$)</p>	1	
	<p>III Some relevant working shown in a minimum of three parts in the calculation. (In (ii) could be $\times 2$ or $\div 2$, in (iii) could $\times 10$ or $\div 10$).</p>	1		
	<p>IV All answers given are quoted to 3 or 4 sig figs (must be a minimum of three steps)</p>	1		
			[Total: 12]	

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2 (a)	MMO Collection	I Two pairs of temperature values recorded as instructed in (a), with units for all readings in (a) and (b) – minimum of 3 readings. <i>Acceptable units are /°C, (°C), temperature in degrees Celsius, temperature in °C.</i>	1	
	PDO Recording	II All thermometer readings recorded to 0.0 °C or 0.5 °C. (check readings in sections 2(a) and 2(b) – minimum of 4 readings).	1	
	ACE Interpretation	III Correct subtractions to give temperature rises and the correct mean value in 2(a). <i>Mean value may be rounded to 0.5 °C or to one d.p or to 0.05 °C and from 0.025 and 0.075 or these may be rounded up or down to nearest 0.1.</i>	1	
Supervisor script: check subtractions and calculate mean ΔT <i>Marks are awarded for comparing the "true" means: check working of candidate and Supervisor. Show Supervisor's mean (corrected if necessary) on the script in a ring.</i>				
	MMO Quality	Award IV and V if candidate's mean temp rise is within 2.0 °C of Supervisor's (incl)	1	
		Award IV if the difference is between 2.0 °C and 3.0 °C.	1	[5]
	PDO Display	Heat produced (J) = $25 \times 4.3 \times \text{temp rise}$ (method mark). <i>Unit is needed in the quoted answer (kJ if divided by 1000).</i>	1	
		Correctly evaluates enthalpy change = $\frac{\text{heat produced}}{0.016}$. <i>Division by 1000 is not required if candidate did this in the previous step. Answer must be negative and to 3 sig figs.</i>	1	[2]

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Examiner to calculate 20% and 40% of supervisor's ΔT and convert to nearest 0.5°C.				
(b)	ACE Interpretation	I Both temperature measurements clearly shown. Award II and III if candidate's temp rise is within 20% of Supervisor's. Award II if candidate's temp rise is within 40% of Supervisor's.	1	[3]
	MMO Quality		1	
			1	
	ACE Interpretation	IV Calculates 0.032 for moles in (ii) or 0.016 for moles in (a)(ii) . V Enthalpy change correctly calculated ($= - \frac{\text{heat change}}{0.032}$). <i>Answer must show negative sign (unless already penalised) and be given to 3 sig figs. (unless already penalised).</i> VI Correct calculation of enthalpy change $\Delta H_1 = \Delta H_2 - \Delta H_3 - 286$	1	[3]
	PDO Display		1	
	ACE Conclusions		1	
(c)	ACE Improvements	Extra/thicker lagging or use a lid or use a vacuum flask	1	[1]
				[Total: 14]

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FA 7 is Zn(NO ₃) ₂ (s); FA 8 is CuSO ₄ (s)					
3	(a) (i)	MMO Collection	No change (or no precipitate or no reaction) both with barium chloride and silver nitrate.	1	[9]
		MMO Collection	Gentle heat: solid melts or dissolves or gives a colourless liquid	1	
	(ii)		Brown fumes/gas produced (allow 'qualified' brown e.g. red/brown, do not allow orange).	1	
			(Gas produced) that relights a glowing splint or yellow solid, goes white on cooling. (Allow precipitate).	1	
	(iii)	ACE Conclusions	FA 7 is a nitrate/nitrite (from some evidence)	1	
	(iv)	MMO Decisions	(Heat) FA 7 with Al foil and NaOH/ecf from anion given.	1	
	(v)	MMO Collection	Gas/vapour/NH ₃ produced and it turns red litmus to blue and confirms that FA 7 contains nitrate/nitrite ions.	1	
		MMO Decisions	Adds ammonia. (<i>This mark is not awarded if a second test is also used</i>)	1	
		ACE Conclusions	Zinc ions are present. (No ecf) (<i>Deduction must be consistent with observations recorded – white ppt soluble in excess.</i>)	1	
(b)	(i)	MMO Collection	With KI, goes yellow/orange/brown and gives a blue (blue-black or purple or black) colour with starch. <i>No reference to the state is required, just the colours.</i>	1	[5]
			Brown/yellow/white/off- white precipitate forms.	1	
	(ii)	ACE Conclusions	KI is the reducing agent (or it is oxidised) as iodine is formed or $2I^- - 2e^- \rightarrow I_2$ or $2Cu^{2+} + 2I^- \rightarrow I_2 + 2Cu^+$ <i>Ignore state symbols.</i>	1	
		MMO Collection	Blue (do not allow dark blue) precipitate obtained, which does not dissolve in excess NaOH	1	
		ACE Conclusions	$Cu^{2+} + 2OH^- \rightarrow Cu(OH)_2$	1	
				[Total: 14]	