

Cambridge
International
AS & A Level

Cambridge International Examinations
Cambridge International Advanced Subsidiary and Advanced Level

CHEMISTRY

9701/31

Paper 3 Advanced Practical Skills 1

May/June 2016

MARK SCHEME

Maximum Mark: 40

Published

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 should be read in conjunction with the question paper and the Principal Examiner Report for Teachers.

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Page 2	Mark Scheme	Syllabus	Paper
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Question	Indicative material	Mark	Total
1 (a)	I Six identifiable masses recorded	1	[7]
	II All recorded masses have unambiguous headings and unit: /g or (g) or g (for each heading) by each entry.	1	
	III Four measured masses all recorded to the same number of decimal places <i>minimum 1 decimal place</i>	1	
	IV Correctly calculates mass of FA1 added and mass of CO ₂ evolved.	1	
	V, VI and VII Examiner compares corrected mass of FA1 / corrected mass of CO ₂ with supervisor value. Accuracy marks are awarded as shown. Award V, VI and VII if $\delta \leq 0.10$ Award V and VI if $0.10 < \delta \leq 0.20$ Award V if $0.20 < \delta \leq 0.40$	3	
(b) (i)	I Correctly calculates $n(\text{CO}_2)$ (mass CO ₂ /44)	1	[5]
(ii)	II Correct equation and all state symbols $\text{XCO}_3(\text{s}) + 2\text{HCl}(\text{aq}) \rightarrow \text{XCl}_2(\text{aq}) + \text{H}_2\text{O}(\text{l}) + \text{CO}_2(\text{g})$	1	
(iii)	III (iii) = (i) and	1	
(iv)	IV Correctly uses 60 and the M _r to calculate A _r of X (mass of FA1 / (iii) – 60)	1	
(iv)	V Identifies X as Group 2 metal or ion with nearest A _r value (must have some working for A _r used). Be 9.0, Mg 24.3, Ca 40.1, Sr 87.6, Ba 137.3	1	
(c) (i)	Apparently more moles of CO ₂ (lost) so A _r of X is smaller. or Apparently more moles of XCO ₃ (used) so A _r of X is smaller.	1	[5]
(ii)	Any 2 from: <ul style="list-style-type: none"> Small loss in mass not much difference to A_r so does not cause confusion in identity / still closest to identity of X	1	

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Question	Indicative material	Mark	Total
(iii)	Any 1 from <ul style="list-style-type: none"> • Add slowly/add a little at a time • Use a taller beaker (accept larger beaker)/use a conical flask • Use less solid • Use less concentrated acid • Use lumps of solid • Use cotton wool plug • Use a lower temperature 	1	[3]
Question 1			[15]
2 (a)	I Initial and final readings and titre value for rough titre and initial and final reading for two (or more) accurate titrations	1	
	II Titre values recorded for accurate titrations and appropriate headings for the accurate titration table and cm ³ units. <ul style="list-style-type: none"> • initial/start burette reading/volume/value • final/end burette and reading/volume/value • titre or volume/FA4 and used/added • unit: /cm³ or (cm³) or in cm³ or cm³ (for each heading) 	1	
	III All accurate burette readings are recorded to nearest 0.05 cm ³ <i>Do not award this mark if:</i> <ul style="list-style-type: none"> • 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) • there is only one accurate titration 	1	
	IV There are two uncorrected, accurate titres within 0.10 cm ³ <ul style="list-style-type: none"> • 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 two initial titres, unless a further titration, within 0.10 cm³ of any other, has also been carried out. • Do not award the mark if any “accurate” burette readings (apart from initial 0 cm³) are given to zero dp 	1	
			[4]

Page 4	Mark Scheme	Syllabus	Paper
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Question	Indicative material	Mark	Total
(b)	<p>Candidate must take the average of two (or more) titres that are within a total spread of not more than 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 be quoted to 2 dp, rounded to the nearest 0.01.</p> <p>Two special cases where the mean may not be to 2 dp:</p> <ul style="list-style-type: none"> • Allow mean expressed to 3 dp only for 0.025 or 0.075 (e.g. 26.325) • Allow mean if expressed 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 allowed) (e.g. 26.0 and 26.1 = 26.1 is incorrect – should be 26.05.) <p>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.</p>	1	[1]
(c) (i)	I Correctly calculates $n(\text{NaOH}) = 0.001$	1	[5]
(ii)	II Shows use of $\frac{250(\text{c})(\text{i})}{(\text{b})}$	1	
(iii)	III Correctly calculates $2 \times 1(\text{b})(\text{i})$	1	
(iv)	IV Shows use of $2(\text{c})(\text{ii}) + 2(\text{c})(\text{iii})$ either as expression or correct calculation	1	
	V Shows use of $/0.025(0)$ or $\times 40$ or $\times 1000/25$	1	
(d) (i)	States that the measuring cylinder/volume of FA2 has the greatest error and should be replaced by burette or pipette	1	[2]
(ii)	Student is correct/greater volume HCl used and greater mass would <u>react with more HCl</u> /would leave <u>less HCl unreacted</u>	1	
Question 2			[12]

Page 5	Mark Scheme	Syllabus	Paper
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Question	Indicative material	Mark	Total
FA5 is MnSO_4 and NH_4Cl ; FA6 is propanone; FA7 is propanal;			
3 (a) (i)	Red litmus turns blue (then red)	1	[2]
	Condensation or sublimation / white smoke / white fumes	1	
(a) (ii) and (b) (i)	NH_4^+ / ammonium in 3(a)(ii) and Mn^{2+} / manganese(II) in 3(b)(i) .	1	
(b) (i)	Selects NaOH and NH_3	1	
	Off-white / beige / light brown precipitate with both NaOH and NH_3	1	
	Both precipitates turns brown / darkens	1	
(ii)	white precipitate and insoluble in acid	1	
(iii)	Selects AgNO_3 / silver nitrate and NH_3 / ammonia	1	
	White precipitate and insoluble / partially soluble in ammonia	1	
	Cannot see if precipitate dissolves in ammonia / Mn^{2+} causes (off-white) precipitate (so cannot be used to distinguish between halides).	1	[8]
(c)	MnCl_2 and $(\text{NH}_4)_2\text{SO}_4$ or MnSO_4 and NH_4Cl	1	[1]
(d)	Both observations required FA6 no reaction / solution turns pink and FA7 turns colourless / decolourises the KMnO_4	1	[2]
	FA6 is either 2-methylpropan-2-ol or propanone as they cannot be oxidised (only 1 needed) and FA7 is propanal as it can be oxidised.	1	
Question 3			[13]