Cambridge International AS & A Level

Cambridge Assessment International Education
Cambridge International Advanced Subsidiary and Advanced Level

CHEMISTRY **9701/31**

Paper 3 Advanced Practical Skills 1 **May/June 2018**

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.

Cambridge International will not enter into discussions about these mark schemes.

Cambridge International is publishing the mark schemes for the May/June 2018 series for most Cambridge IGCSE™, Cambridge International A and AS Level and Cambridge Pre-U components, and some Cambridge O Level components.

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Generic Marking Principles

These general marking principles must be applied by all examiners when marking candidate answers. They should be applied alongside the specific content of the mark scheme or generic level descriptors for a question. Each question paper and mark scheme will also comply with these marking principles.

GENERIC MARKING PRINCIPLE 1:

Marks must be awarded in line with:

- the specific content of the mark scheme or the generic level descriptors for the question
- the specific skills defined in the mark scheme or in the generic level descriptors for the question
- the standard of response required by a candidate as exemplified by the standardisation scripts.

GENERIC MARKING PRINCIPLE 2:

Marks awarded are always **whole marks** (not half marks, or other fractions).

GENERIC MARKING PRINCIPLE 3:

Marks must be awarded **positively**:

- marks are awarded for correct/valid answers, as defined in the mark scheme. However, credit is given for valid answers which go beyond the scope of the syllabus and mark scheme, referring to your Team Leader as appropriate
- marks are awarded when candidates clearly demonstrate what they know and can do
- marks are not deducted for errors
- marks are not deducted for omissions
- answers should only be judged on the quality of spelling, punctuation and grammar when these features are specifically assessed by the question as indicated by the mark scheme. The meaning, however, should be unambiguous.

GENERIC MARKING PRINCIPLE 4:

Rules must be applied consistently e.g. in situations where candidates have not followed instructions or in the application of generic level descriptors.

GENERIC MARKING PRINCIPLE 5: Marks should be awarded using the full range of marks defined in the mark scheme for the question (however; the use of the full mark range may be limited according to the quality of the candidate responses seen).
GENERIC MARKING PRINCIPLE 6: Marks awarded are based solely on the requirements as defined in the mark scheme. Marks should not be awarded with grade thresholds or grade descriptors in mind.

Question	Answer	Marks
1(a)	**I** Initial and final readings and titre recorded for rough titre **and** accurate titre details tabulated *(minimum 2 × 2 'boxes')*	**1**
	II All **three** headings and units correct for accurate titrations Headings: initial / final (burette) **and** reading / volume / vol **or** reading / volume / vol at start / finish (but not V) **and** volume / **FA 2 and** 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 0.1 cm^3 of any other accurate titre.	**1**
All burette readings should be rounded to the nearest 0.05 cm^3. Subtractions should be checked. The 'best' titres should be selected using the hierarchy: two (or more) identical; then 2 (or more) within 0.05 cm^3; then two (or more) within 0.1 cm^3, etc, the mean titre calculated and this then compared with the supervisor mean titre.		
	V, VI and VII Award **V, VI and VII** for a difference from supervisor within 0.20 cm^3 Award **V and VI** for $0.20 < \delta \leqslant 0.40$ cm^3 Award **V** for $0.40 < \delta \leqslant 0.60$ cm^3	**3**

Question	Answer	Marks
1(b)	Candidate must average two (or more) titres for which the total spread is not greater than 0.2 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. Example: 26.667 must be rounded to 26.67.* *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.* *Do **not** award this mark if:* *any selected titre is not within 0.20 cm^3 of any other selected titre;* *the rough titre was used to calculate the mean;* *the candidate carried out only 1 accurate titration;* *burette readings were incorrectly subtracted to obtain any of the accurate titre values.* *All burette readings, excluding initial 0, (resulting in titre values used in calculation of mean) are integers.* *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.*	**1**
1(c)(i)	All answers to **(c)** correct to 3 or 4 sig figs.	**1**
1(c)(ii)	Correctly calculates moles Na_2CO_3 in 25.0 cm^3 **FB 1** = $\frac{1.30}{106 \times 10}$	**1**
1(c)(iii)	Correctly calculates answer to **(c)(ii)** $\times$ 2	**1**
1(c)(iv)	Correctly uses $\frac{\text{answer to (iii)} \times 1000}{\text{Volume from (b)}}$	**1**

Question	Answer	Marks
2(a)	**I** Initial and final readings and titre recorded for a minimum of two **accurate** titre details tabulated *(minimum 2 × 3 'boxes')*	**1**
All burette readings should be rounded to the nearest 0.05 cm^3. Subtractions should be checked. The 'best' titres should be selected using the hierarchy: two (or more) identical; then 2 (or more) within 0.05 cm^3; then two (or more) within 0.1 cm^3, etc the mean titre calculated and this then compared with the supervisor's value.		
	II and III Award **II and III** for $\delta \leqslant 0.20\ cm^3$ Award **II** for $0.20 < \delta \leqslant 0.40\ cm^3$	**2**
2(b)(i)	Correctly calculates moles HCl = $\frac{\text{vol of } \mathbf{FA\ 2} \text{ from } \mathbf{(a)} \times 0.100}{1000}$ **and** moles NaOH are the same	**1**
2(b)(ii)	Correctly calculates moles NaOH added to **W** = 0.40 × 250 ÷ 1000 = 0.10 **and** moles NaOH remaining = answer to **(b)(i)** × 10	**1**
2(b)(iii)	Correctly uses moles NaOH reacting with **W** = 1st answer in **(b)(ii)** – 2nd answer in **(b)(ii)** (0.10 – 2nd answer in **(b)(ii)**) **and** moles **W** = answer ÷ 2	**1**
2(b)(iv)	Correctly uses M_r of **W** = 4 ÷ answer to **(b)(iii)**	**1**
2(b)(v)	Expression to show 59 + A_r of X = M_r from **(b)(iv)**	**1**
	Identification of X as halogen with nearest A_r to that calculated	**1**
2(c)	Error: Mass was given correct to 1 sig fig / nearest g Modification: Use a more accurate balance **or** Error: Hydrolysis of halogeno group may be incomplete Modification: Use more concentrated NaOH / heat for longer	**1**

Question	Answer	Marks
2(d)	If F chosen then 87 If C*l* chosen then 86 or 117 If Br chosen then 116 or 163 If I chosen then 162	**1**

Question	Answer	Marks
FA 5 is HCOOH ; **FA 7** is $ZnCO_3$; **FA 8** is $Cu(NO_3)_2$		
3(a)(i)	+ Na_2CO_3: fizz / effervescence / bubbling	**1**
	+ $KMnO_4$: purple (allow pink) to colourless (allow pale yellow)	**1**
	+ $AgNO_3$: no (visible) reaction / no change / no ppt / solution remains colourless	**1**
	+ Tollens': silver mirror / black ppt / grey ppt	**1**
3(a)(ii)	(Carboxylic) acid	**1**
	Aldehyde / primary alcohol / secondary alcohol / alkene	**1**
3(b)(i)	+ acid: fizz / effervescence / bubbling	**1**
	Gas / CO_2 / fizz turns limewater milky / cloudy white / forms white ppt	**1**
	+ NaOH: white ppt soluble in excess NaOH	**1**

Question	Answer	Marks
3(b)(ii)	+ NaOH: (pale) blue ppt (reference to dark blue or dissolving is CON)	**1**
	Warming: goes black / brown / grey	**1**
	+ A*l* & NaOH: gas / ammonia turns litmus blue	**1**
3(b)(iii)	Cu^{2+} / copper(II) definitely present	**1**
	Zn^{2+} or Al^{3+} / aluminium or zinc could be present	**1**
	Add (aqueous) ammonia – give (white) ppt but **only** (that from) zinc dissolves in excess	**1**
3(b)(iv)	CO_3^{2-} / carbonate definitely present	**1**
	NO_3^- or NO_2^- / nitrate or nitrite could be present	**1**