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 **October/November 2019**

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.

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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.

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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.

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Question	Answer	Marks
1(a)	3 masses recorded with unambiguous headings in the space provided, with correct units mass used correctly calculated volume of gas collected or final volume recorded with correct units	**1**
	Award this mark if volume recorded by candidate lies within ± 10% of supervisor value.	**1**
1(b)(i)	Correctly calculates volume of gas in cm^3 / 24 000 answer to 2–4 sf	**1**
1(b)(ii)	Correct use of: 2 × **AND** ans **(b)(i)** / 0.025 (answer to 2–4 sf)	**1**
1(b)(iii)	Correctly uses ans **(b)(i)** × 24.3 **and** answer to 2–4 sf	**1**
1(c)	Student correct as reaction now **slower** so **less gas lost** (while bung is being fitted).	**1**
	Student incorrect as Mg is in excess. **or** Student incorrect as reaction is **faster** so **more gas lost**	**1**
1(d)	**gas** volume / amount / moles lower so concentration is lower	**1**

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Question	Answer	Marks
2(a)	**I** Uses a volume between 40.00 and 45.00 cm^3 **and** answer to at least 1 dp	**1**
	II The following data must be shown • burette readings ***and*** titre for rough titration • 2 × 2 'box' showing both accurate burette readings	**1**
	III Headings and units correct for accurate titration table and headings match readings. • Initial / start (burette) and reading / volume + unit • Final / end (burette) and reading / volume + unit • titre or volume / **FA 4** and used / added (*not 'difference' amount or 'total')* + unit	**1**
	IV All accurate burette readings to 0.05 cm^3	**1**
	V The final accurate titre recorded is within 0.10 cm^3 of any other accurate titre.	**1**
	Award **VI** if $20 < \delta \leqslant 30$ cm^3	**1**
	Award **VII** if $10 < \delta \leqslant 20$ cm^3	**1**
	Award **VIII** if $\delta \leqslant 10$ cm^3	**1**
2(b)	Candidate must average two (or more) titres that are **all** within 0.20 cm^3. Working must be shown or ticks must be put next to the two (or more) accurate titres selected.	**1**
2(c)(i)	Answers for **(ii)**, **(iii)** and **(iv)** given to 3–4 sf. Minimum three answers displayed.	**1**
2(c)(ii)	Correctly calculates 2.50×10^{-3}	**1**
2(c)(iii)	Correct use of ans **(c)(ii)** × 1000 / ans **(b)**	**1**
2(c)(iv)	Correct expression: ans **(c)(iii)** × 250 / vol used from **(a)**	**1**
2(d)	Correctly calculates 0.10 / vol used in **(a)** × 100.	**1**

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Question	Answer	Marks
2(e)	**Question 1** • measuring cylinder **greater** error than **burette / pipette** • molar gas volume of 24 dm^3 may not be valid / temperature of the lab may not be known • too much gas for the measuring cylinder (check that vol $>$ 250 cm^3) • use gas syringe (if volume $<$ 100 cm^3)	**1**
	Question 2 • dilution introduces extra stage / greater cumulative error • methyl orange **end-point** can be difficult to see / **colour change** gradual / difficult to see	**1**

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Question	Answer	Marks
	FA 5 is $Al NH_4(SO_4)_2.12H_2O$; **FA 8** is KI and $FeSO_4$	
3(a)(i)	• melts / dissolves • condensation / moisture on the walls of the test-tube / steam produced • white smoke / fumes (NOT gas) • (gas) turns red litmus blue • gas turns blue litmus red • white residue Award 1 mark for two correct observations from the list, award 2 marks for three or more correct observations. If both gas observations are given they must be in the correct order for both to be credited.	**2**
3(a)(ii)	NH_3 White ppt and insoluble in excess	**1**
	NaOH White ppt and sol in excess **Allow** 1 mark for white ppt with both NH_3 and NaOH	**1**
	hot NaOH Gas / NH_3 (on warming) turns red litmus blue	**1**
	Ba^{2+} White ppt insoluble in acid / white ppt no reaction with acid **Reject** white ppt **formed** when acid added	**1**
3(a)(iii)	names or correct formulae	**1**
	NH_4^+ , Al^{3+} , SO_4^{2-} Award 1 mark for two ions, award 2 marks for three ions.	**1**

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Question	Answer	Marks
3(b)	Any formula (involving all three ions) in which the charges on the ions cancel (e.g. $K_3Cr(SO_4)_3$)	**1**
	$KCr(SO_4)_2.12H_2O$	**1**
3(c)(i)	Red-brown (allow yellow / yellow-brown / orange / orange-brown / brown) (solution) **or** $KMnO_4$ / purple decolourises **and** turns blue-black / **dark** blue / black (on adding starch)	**1**
	Green ppt **and** insoluble in excess / turns brown (on standing) **Reject** grey-green	**1**
3(c)(ii)	Fe^{2+} / iron(II) **and** I^- / iodide This mark is free-standing	**1**
3(c)(iii)	Uses silver nitrate **and** yellow ppt	**1**
	ppt insoluble in HNO_3 **or** ppt insoluble in NH_3 (nitric acid may be added initially)	**1**
3(c)(iv)	$Fe^{2+}(aq) + 2OH^-(aq) \rightarrow Fe(OH)_2(s)$ ecf for Cr^{3+} / Cu^{2+} / Fe^{3+} or any other transition metal ion concluded in **(ii)**.	**1**

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