Cambridge International AS & A Level

Cambridge Assessment International Education
Cambridge International Advanced Subsidiary and Advanced Level

CHEMISTRY	**9701/21**
Paper 2 AS Level Structured Questions	**May/June 2019**
MARK SCHEME	
Maximum Mark: 60	

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 2019 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**:

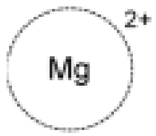
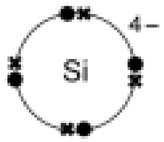
- marks are awarded for correct/valid answers, as defined in the mark scheme. However, credit is given for valid answers which go beyond the scope of the syllabus and mark scheme, referring to your Team Leader as appropriate
- marks are awarded when candidates clearly demonstrate what they know and can 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:

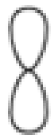
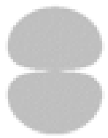
Rules must be applied consistently e.g. in situations where candidates have not followed instructions or in the application of generic level descriptors.

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)	**M1** (one) fewer (inner) shell of electrons / less shielding (effect) *ORA*	**1**
	M2 smaller distance of the **outer** electrons (from the nucleus) / stronger nuclear attraction to the (outer) electrons *ORA*	**1**
1(a)(ii)	$Sr(s) + 2H_2O(l) \rightarrow Sr(OH)_2(aq) + H_2(g)$ **M1** species AND balancing	**1**
	M2 state symbols	**1**
1(a)(iii)	**M1** strontium AND forms a more soluble hydroxide	**1**
	M2 strontium hydroxide is a stronger base / produces more OH^- / it dissociates more	**1**
1(a)(iv)	(white) **solid** dissolves / effervescence	**1**
1(b)(i)	Similarities (any two from the following list) (both have) +2 ion / (+2) same oxidation state / same stoichiometry of oxide / carbonates decompose (on heating)	**2**
	Difference (X) forms coloured compounds/oxides/ carbonates **OR** Group 2 elements form white compounds/oxides/carbonates	**1**
1(b)(ii)	XO	**1**
1(b)(iii)	$XCO_3 \rightarrow XO + CO_2$	**1**

Question	Answer	Marks
2(a)	**M1** *magnesium* +2 charge on **two** Mg AND both with 0 or 8 electrons  **OR** 	**1**
	M2 *silicide* -4 charge on one Si and 8 electrons 	**1**
2(b)	$Mg_2Si(s) + 4H_2O(l) \rightarrow 2Mg(OH)_2(aq) + SiH_4(g)$ **M1** correct balancing and formulae	**1**
	M2 state symbols	**1**
2(c)	**M1** simple (covalent) / molecular / molecules	**1**
	M2 weak IMF / (temporary) induced dipole (forces)	**1**
2(d)(i)	$C^{\delta-}$–$H^{\delta+}$	**1**
	$Si^{\delta+}$–$H^{\delta-}$	**1**
2(d)(ii)	**M1** tetrahedral (molecule)	**1**
	M2 (so individual bond) dipoles / partial charges cancel	**1**
2(e)	**M1** Si—H bond is (much) weaker than C—H bond	**1**
	M2 low activation energy *ORA*	**1**

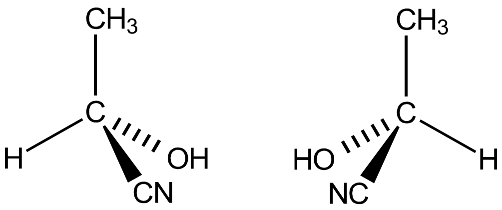
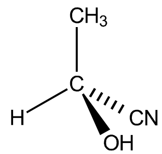
Question	Answer	Marks
2(f)(i)	**M1** sodium silicate / Na_2SiO_3	**1**
	M2 water / H_2O	**1**
2(f)(ii)	acid(ic)	**1**

Question	Answer	Marks
3(a)	$Ar^{+}(g) \rightarrow Ar^{2+}(g) + e^{(-)}$ **OR** $Ar^{+}(g) - e^{(-)} \rightarrow Ar^{2+}(g)$	**1**
3(b)	at $x = 8$, within range 13000–20000	**1**
	at $x = 9$, within range 35000–45000	**1**
3(c)	 **OR** 	**1**
3(d)(i)	**M1** *correct conversions of data to SI/consistent units* $p = 404\,000$; $V = 20 \times 10^{-6}$; $T = 298$	**1**
	M2 *calculation of n (= pV/RT) from **M1** values* $n = \dfrac{404000 \times 20 \times 10^{-6}}{8.31 \times 298} = 3.263 \times 10^{-3}$ mol of Cl_2	**1**
	M3 *finding the mass of Cl_2* $= 3.263 \times 10^{-3} \times 71.0 = 0.23$ (g)	**1**

Question	Answer	Marks
3(d)(ii)	**Method 1** **M1** = $3.263 \times 10^{-3} \times 2$ **Method 2** **M1** = $\frac{0.23}{71.0} \times 2$ **OR** 6.53×10^{-3}	1
	Method 1 **M2** = $6.02 \times 10^{23} \times$ **M1** = 3.93×10^{21} atoms of C*l* **Method 2** **M2** = $6.02 \times 10^{23} \times$ **M1** = 3.90×10^{21} atoms of C*l*	1
3(d)(iii)	**M1** size / volume of **molecule / particle** becomes significant / non-negligible **OR** IMFs become significant / non-negligible	1
	M2 IMFs becomes significant / non-negligible / collisions are not elastic	1

Question	Answer	Marks
4(a)	3-chloroprop-1-ene	1
4(b)	*a* = 109(.5)°	1
	b = 120°	1
4(c)(i)	$C_3H_7ClO_2$	1
4(c)(ii)	oxidation	1

Question	Answer	Marks
4(c)(iii)	<table><tr><td></td><td>alcohol group present in Z</td></tr><tr><td>primary</td><td>✓</td></tr><tr><td>secondary</td><td>✓</td></tr><tr><td>tertiary</td><td></td></tr></table>	**1**
4(d)(i)	A and B	**1**
4(d)(ii)	<table><tr><td></td><td>Compound(s)</td><td>Observation</td></tr><tr><td>Reaction with Tollens' reagent</td><td>B ✓</td><td>**silver** mirror OR grey / black / brown / silver precipitate ✓</td></tr></table>	**2**
	<table><tr><td></td><td>Compound(s)</td><td>Observation</td></tr><tr><td>Reaction with alkaline aq. iodine</td><td>A ✓ and C ✓</td><td>(Pale) yellow precipitate /solid ✓</td></tr></table>	**3**
	<table><tr><td></td><td>Compound(s)</td><td>Observation</td></tr><tr><td>Reaction with sodium metal</td><td>C ✓ and D✓</td><td>Effervescence / sodium/solid disappears ✓</td></tr></table>	**3**

Question	Answer	Marks
5(a)	**M1** a lone pair / electron pair donor	**1**
	M2 $(:)CN^-$ / $^-(:)CN$ / cyanide ion	**1**
5(b)(i)	optical	**1**
5(b)(ii)	 **M1** one 3-D structure of **correct** molecule shown.	**1**
	M2 a mirror image of the molecule drawn in **M1** **OR** same profile with two groups swapped (*e.g.* )	**1**
	M3 central chiral C shown as *	**1**
5(c)	$CH_3CH(OH)CO_2H$ **OR** $HO_2CCH(OH)CH_3$	**1**