
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.

This document consists of **9** printed pages.

PUBLISHED**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.

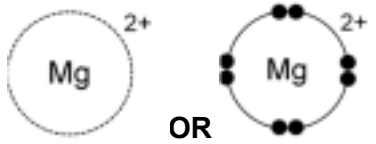
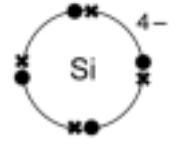
GENERIC MARKING PRINCIPLE 5:

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).

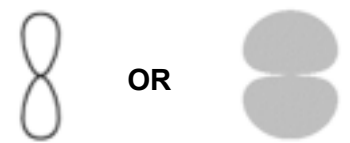
GENERIC MARKING PRINCIPLE 6:

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) <i>ORA</i>	1
	M2 smaller distance of the outer electrons (from the nucleus) / stronger nuclear attraction to the (outer) electrons <i>ORA</i>	1
1(a)(ii)	$\text{Sr(s)} + 2\text{H}_2\text{O(l)} \rightarrow \text{Sr(OH)}_2\text{(aq)} + \text{H}_2\text{(g)}$	1
	M1 species AND balancing	
	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 / <u>carbonates</u> 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)	$\text{XCO}_3 \rightarrow \text{XO} + \text{CO}_2$	1

Question	Answer	Marks
2(a)	<p>M1 magnesium +2 charge on two Mg AND both with 0 or 8 electrons</p> 	1
	<p>M2 silicide -4 charge on one Si and 8 electrons</p> 	1
2(b)	<p>$\text{Mg}_2\text{Si}(\text{s}) + 4\text{H}_2\text{O}(\text{l}) \rightarrow 2\text{Mg}(\text{OH})_2(\text{aq}) + \text{SiH}_4(\text{g})$</p> <p>M1 correct balancing and formulae</p> <p>M2 state symbols</p>	1
2(c)	<p>M1 simple (covalent) / molecular / molecules</p> <p>M2 weak IMF / (temporary) induced dipole (forces)</p>	1
2(d)(i)	<p>$\text{C}^{\delta-}-\text{H}^{\delta+}$</p> <p>$\text{Si}^{\delta+}-\text{H}^{\delta-}$</p>	1
2(d)(ii)	<p>M1 tetrahedral (molecule)</p> <p>M2 (so individual bond) dipoles / partial charges cancel</p>	1
2(e)	<p>M1 Si—H bond is (much) weaker than C—H bond</p> <p>M2 low activation energy <i>ORA</i></p>	1

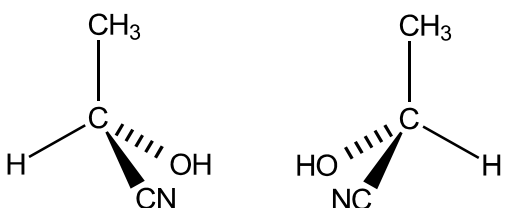
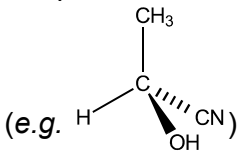
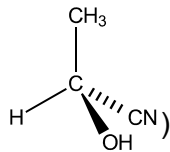
Question	Answer	Marks
2(f)(i)	M1 sodium silicate / Na_2SiO_3	1
	M2 water / H_2O	1
2(f)(ii)	acid(ic)	1

Question	Answer	Marks
3(a)	$\text{Ar}^+(\text{g}) \rightarrow \text{Ar}^{2+}(\text{g}) + \text{e}^{(-)}$ OR $\text{Ar}^+(\text{g}) - \text{e}^{(-)} \rightarrow \text{Ar}^{2+}(\text{g})$	1
3(b)	at $x = 8$, within range 13000–20000	1
	at $x = 9$, within range 35000–45000	1
3(c)		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 $n = \frac{404000 \times 20 \times 10^{-6}}{8.31 \times 298} = 3.263 \times 10^{-3} \text{ mol of Cl}_2$	1
	M3 finding the mass of Cl_2 $= 3.263 \times 10^{-3} \times 71.0 = 0.23 \text{ (g)}$	1

Question	Answer	Marks		
3(d)(ii)	<table border="1"> <tr> <td>Method 1 $M1 = 3.263 \times 10^{-3} \times 2$</td> <td>Method 2 $M1 = \frac{0.23}{71.0} \times 2$ OR 6.53×10^{-3}</td> </tr> </table>	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 $M1 = 3.263 \times 10^{-3} \times 2$	Method 2 $M1 = \frac{0.23}{71.0} \times 2$ OR 6.53×10^{-3}		
<table border="1"> <tr> <td>M2 = $6.02 \times 10^{23} \times M1$ = 3.93×10^{21} atoms of Cl</td> <td>M2 = $6.02 \times 10^{23} \times M1$ = 3.90×10^{21} atoms of Cl</td> </tr> </table>	M2 = $6.02 \times 10^{23} \times M1$ = 3.93×10^{21} atoms of Cl	M2 = $6.02 \times 10^{23} \times M1$ = 3.90×10^{21} atoms of Cl	1	
M2 = $6.02 \times 10^{23} \times M1$ = 3.93×10^{21} atoms of Cl	M2 = $6.02 \times 10^{23} \times M1$ = 3.90×10^{21} atoms of Cl			
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)	$a = 109(.5)^\circ$	1
	$b = 120^\circ$	1
4(c)(i)	$C_3H_7ClO_2$	1
4(c)(ii)	oxidation	1

Question	Answer			Marks								
4(c)(iii)	<table border="1" data-bbox="920 220 1357 515"> <tr> <td data-bbox="920 220 1144 320"></td> <td data-bbox="1144 220 1357 320">alcohol group present in Z</td> </tr> <tr> <td data-bbox="920 320 1144 384">primary</td> <td data-bbox="1144 320 1357 384">✓</td> </tr> <tr> <td data-bbox="920 384 1144 448">secondary</td> <td data-bbox="1144 384 1357 448">✓</td> </tr> <tr> <td data-bbox="920 448 1144 515">tertiary</td> <td data-bbox="1144 448 1357 515"></td> </tr> </table>				alcohol group present in Z	primary	✓	secondary	✓	tertiary		1
	alcohol group present in Z											
primary	✓											
secondary	✓											
tertiary												
4(d)(i)	A and B			1								
4(d)(ii)	<table border="1" data-bbox="506 616 1771 783"> <tr> <td data-bbox="506 616 958 679"></td> <td data-bbox="958 616 1167 679">Compound(s)</td> <td data-bbox="1167 616 1771 679">Observation</td> </tr> <tr> <td data-bbox="506 679 958 783">Reaction with Tollens' reagent</td> <td data-bbox="958 679 1167 783">B ✓</td> <td data-bbox="1167 679 1771 783">silver mirror OR grey / black / brown / silver precipitate ✓</td> </tr> </table>				Compound(s)	Observation	Reaction with Tollens' reagent	B ✓	silver mirror OR grey / black / brown / silver precipitate ✓	2		
		Compound(s)	Observation									
	Reaction with Tollens' reagent	B ✓	silver mirror OR grey / black / brown / silver precipitate ✓									
	<table border="1" data-bbox="506 815 1771 951"> <tr> <td data-bbox="506 815 958 879"></td> <td data-bbox="958 815 1167 879">Compound(s)</td> <td data-bbox="1167 815 1771 879">Observation</td> </tr> <tr> <td data-bbox="506 879 958 967">Reaction with alkaline aq. iodine</td> <td data-bbox="958 879 1167 967">A ✓ and C ✓</td> <td data-bbox="1167 879 1771 967">(Pale) yellow precipitate /solid ✓</td> </tr> </table>				Compound(s)	Observation	Reaction with alkaline aq. iodine	A ✓ and C ✓	(Pale) yellow precipitate /solid ✓	3		
		Compound(s)	Observation									
	Reaction with alkaline aq. iodine	A ✓ and C ✓	(Pale) yellow precipitate /solid ✓									
<table border="1" data-bbox="506 987 1771 1118"> <tr> <td data-bbox="506 987 958 1051"></td> <td data-bbox="958 987 1167 1051">Compound(s)</td> <td data-bbox="1167 987 1771 1051">Observation</td> </tr> <tr> <td data-bbox="506 1051 958 1126">Reaction with sodium metal</td> <td data-bbox="958 1051 1167 1126">C ✓ and D ✓</td> <td data-bbox="1167 1051 1771 1126">Effervescence / sodium/solid disappears ✓</td> </tr> </table>				Compound(s)	Observation	Reaction with sodium metal	C ✓ and D ✓	Effervescence / sodium/solid disappears ✓	3			
	Compound(s)	Observation										
Reaction with sodium metal	C ✓ and D ✓	Effervescence / sodium/solid disappears ✓										

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 ₃ CH(OH)CO ₂ H OR HO ₂ CCH(OH)CH ₃	1