Cambridge Assessment International Education

Cambridge International AS & A Level

CHEMISTRY **9701/22**

Paper 2 AS Level Structured Questions **March 2020**

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 March 2020 series for most Cambridge IGCSE™, Cambridge International A and AS Level 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.

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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.

Science-Specific Marking Principles

1	Examiners should consider the context and scientific use of any keywords when awarding marks. Although keywords may be present, marks should not be awarded if the keywords are used incorrectly.
2	The examiner should not choose between contradictory statements given in the same question part, and credit should not be awarded for any correct statement that is contradicted within the same question part. Wrong science that is irrelevant to the question should be ignored.
3	Although spellings do not have to be correct, spellings of syllabus terms must allow for clear and unambiguous separation from other syllabus terms with which they may be confused (e.g. ethane / ethene, glucagon / glycogen, refraction / reflection).
4	The error carried forward (ecf) principle should be applied, where appropriate. If an incorrect answer is subsequently used in a scientifically correct way, the candidate should be awarded these subsequent marking points. Further guidance will be included in the mark scheme where necessary and any exceptions to this general principle will be noted.

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5 <u>'List rule' guidance</u> (see examples below)

For questions that require ***n*** responses (e.g. State **two** reasons …):

- The response should be read as continuous prose, even when numbered answer spaces are provided
- Any response marked *ignore* in the mark scheme should not count towards ***n***
- Incorrect responses should not be awarded credit but will still count towards ***n***
- Read the entire response to check for any responses that contradict those that would otherwise be credited. Credit should **not** be awarded for any responses that are contradicted within the rest of the response. Where two responses contradict one another, this should be treated as a single incorrect response
- Non-contradictory responses after the first ***n*** responses may be ignored even if they include incorrect science.

6 <u>Calculation specific guidance</u>

Correct answers to calculations should be given full credit even if there is no working or incorrect working, **unless** the question states 'show your working'.

For questions in which the number of significant figures required is not stated, credit should be awarded for correct answers when rounded by the examiner to the number of significant figures given in the mark scheme. This may not apply to measured values.

For answers given in standard form, (e.g. $a \times 10^n$) in which the convention of restricting the value of the coefficient (a) to a value between 1 and 10 is not followed, credit may still be awarded if the answer can be converted to the answer given in the mark scheme.

Unless a separate mark is given for a unit, a missing or incorrect unit will normally mean that the final calculation mark is not awarded. Exceptions to this general principle will be noted in the mark scheme.

7 <u>Guidance for chemical equations</u>

Multiples / fractions of coefficients used in chemical equations are acceptable unless stated otherwise in the mark scheme.

State symbols given in an equation should be ignored unless asked for in the question or stated otherwise in the mark scheme.

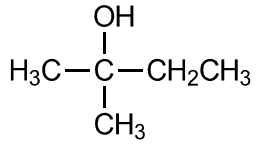
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Question	Answer	Marks
1(a)(i)	$CaO + H_2O \rightarrow Ca(OH)_2$	**1**
1(a)(ii)	OH^- / hydroxide	**1**
1(b)	**M1** (decreasing melting point down the group because) lower forces of attraction / weaker bonds (between cations and anions / oxide / O^{2-}) **M2** larger cations and constant charge OR decreasing charge density of cation (down group)	**2**
1(c)	high(er) activation energy / heating overcomes activation energy	**1**
1(d)	180(°)	**1**
1(e)(i)	reacts with / behaves as both acid and base	**1**
1(e)(ii)	$BeO + 2OH^- + H_2O \rightarrow Be(OH)_4^{2-}$	**1**
1(f)(i)	**M1** equal rates of forward and backward reactions **M2** closed system **OR** macroscopic properties unchanging	**2**
1(f)(ii)	**M1** Cl_2 O_2 initial x 0 mol equilibrium $0.3x$ $0.35x$ mol **mol fraction** $\mathbf{\frac{6}{13}}$ $\mathbf{\frac{7}{13}}$ **M2** $K_p = \frac{100\,000 \times \frac{7}{13}}{\left(100\,000 \times \frac{6}{13}\right)^2} = 2.53 \times 10^{-5}$ **M3** Pa^{-1}	**3**

Question	Answer	Marks
1(g)(i)	–1	**1**
1(g)(ii)	**M1** (enthalpy / energy change) when one mole of a compound / substance is formed **M2** from its elements in their standard states	**2**
1(g)(iii)	$-(-602 + -188) + (\Delta H_f [MgO_2] + -286) = -96$ $\Delta H_f[MgO_2] = -600$ (kJ mol^{-1})	**2**
1(g)(iv)	$-(-600) - (+602) = -2$ (kJ mol^{-1})	**1**

Question	Answer	Marks
2(a)	darker / stronger / deeper down the group	**1**
2(b)(i)	weaker oxidising agents / (relative reactivity as oxidising agents) decreases **down the group**	**1**
2(b)(ii)	**M1** (structure =) simple / molecular, because it has a low melting / boiling point **M2** (bonding =) covalent, because it is hydrolysed	**2**
2(c)(i)	**M1** cream ppt / solid **M2** (ppt / solid) partially dissolves in (aqueous) ammonia	**2**

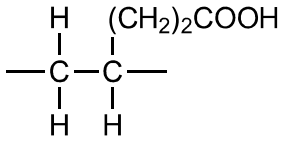
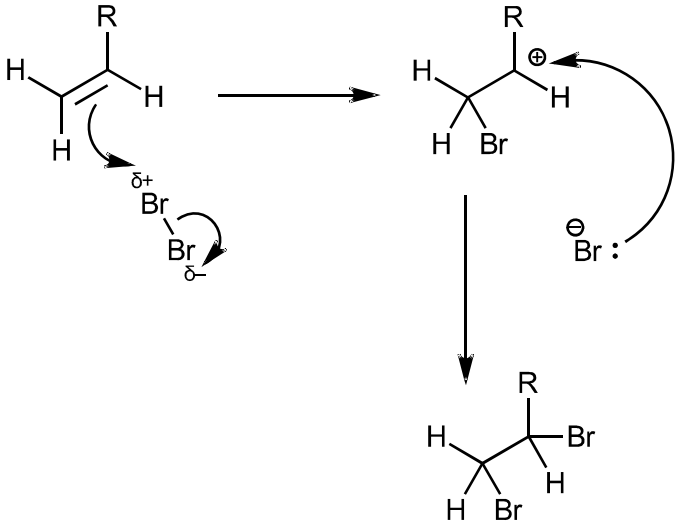
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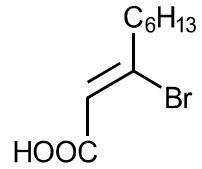
Question	Answer	Marks
2(c)(ii)	**M1** *Acid behaviour of H_2SO_4* H_2SO_4 acts as an acid with Cl^- OR acid / base reaction with Cl^- **M2** *Oxidising behaviour of H_2SO_4* H_2SO_4 acts as an oxidising agent with I^- OR H_2SO_4 does not oxidise Cl^- **M3** *Products formed* (for iodide reaction) I_2 / S / SO_2 / H_2S is formed OR (for chloride reaction) (only) HCl is formed OR *Comparison of oxidising strength* H_2SO_4 not strong enough to / cannot oxidise Cl^- (to Cl_2) OR I^- more powerful reducing agent than Cl^-	**3**
2(d)(i)	**M1** increases (down the group) because of increasing VdW **M2** because of increasing number of electrons	**2**
2(d)(ii)	**M1** less stable (down the group) / decreases **M2** lower H–Hal bond enthalpy / energy	**2**
2(e)(i)	in the same phase / state	**1**
2(e)(ii)	$C_2H_5CH(OH)C_2H_5 + HCl \rightarrow C_2H_5CH(Cl)C_2H_5 + H_2O$	**1**
2(e)(iii)		**1**
2(e)(iv)	substitution	**1**

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Question	Answer	Marks
3(a)(i)	**M1** acidified / H^+ $Cr_2O_7^{2-}$ / (potassium / sodium) dichromate OR manganate(VII) / MnO_4^- / $KMnO_4$ **M2** (heat under) reflux	**2**
3(a)(ii)	nucleophilic addition	**1**
3(a)(iii)	yellow / orange / red ppt / solid	**1**
3(a)(iv)	it does not have four different (groups of) atoms attached to (central) carbon OR it does not have a chiral carbon / centre OR it has two identical / COOH groups attached to (central) carbon OR mirror image is super(im)posable	**1**
3(a)(v)	**M1** hydrolysis **M2** esterification / condensation	**2**
3(b)(i)	**M1** no. of mol $O_2 = \frac{1.00\times10^5\times1.06\times10^{-3}}{(8.31\times850)}$ **M2** no. of mol of nitroglycerine = $4\times0.0150 = 0.0600$ (mol) **M3** mass of nitroglycerine = $0.0600\times227 = 13.6(2)$ (g)	**3**
3(b)(ii)	$1.06\times29 = 30.7(4)$ dm^3	**1**
3(c)(i)	$C_5H_8O_2$	**1**

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Question	Answer	Marks
3(c)(ii)		1
3(c)(iii)	 **M1** curly arrow from C=C double bond to Br **M2** correct dipole in Br_2 **AND** curly arrow from Br—Br to $Br^{\delta-}$ **M3** correct intermediate **AND** curly arrow from lone pair on Br^- to C^+ **M4** correct product	4

Question	Answer	Marks
3(d)(i)	**M1**  **M2** (two) different groups on each C atom in the C=C / end of the C=C double bond **M3** no / restricted rotation about C=C	**3**
3(d)(ii)	H_2 / hydrogen	**1**
3(d)(iii)	**M1 / M2** *absorptions seen in both spectra (any two):* (same) both show an absorption at 1680–1730 (cm^{-1}) because of C=O (same) both show an absorption at 1040–1300 (cm^{-1}) because of C–O (same) both show an absorption at 2500–3000 (cm^{-1}) because of RCO_2–H / O–H in RCO_2H / carboxyl(ic acid) **M3** *absorption only seen in spectrum of* **T***:* (different) **T** shows an absorption at 1500–1680 (cm^{-1}) because of C=C (different) **T** shows an absorption at 3000–3100 (cm^{-1}) because of (C=)C–H	**3**

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