Cambridge Assessment International Education

Cambridge International AS & A Level

CHEMISTRY **9701/02**

Paper 2 AS Level Structured Questions **For examination from 2022**

MARK SCHEME

Maximum Mark: 60

Specimen

This document has **10** pages. Blank pages are indicated.

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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.

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.
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.

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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.

Mark scheme abbreviations:

;	separates marking points
/	separates alternatives within a marking point
R	reject
I	ignore mark as if this material was not present
A	accept (a less than ideal answer which should be marked)
COND	indicates mark is conditional on previous marking point
OWTTE	or words to that effect (accept other ways of expressing the same idea)
AW	alternative wording (where responses vary more than usual)
<u>underline</u>	actual word given must be used by candidate (grammatical variants accepted)
max	indicates the maximum number of marks that can be awarded
ECF	credit a correct statement that follows a previous wrong answer
( )	the word / phrase in brackets is not required, but sets the context
ORA	or reverse argument

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Examples of how to apply the list rule

State **three** reasons ... [3]

A

1. Correct	✓	**2**
2. Correct	✓	
3. Wrong	×	

B (4 responses)

1. Correct, Correct	✓, ✓	**3**
2. Correct	✓	
3. Wrong	ignore	

C (4 responses)

1. Correct	✓	**2**
2. Correct, Wrong	✓, ×	
3. Correct	ignore	

D (4 responses)

1. Correct	✓	**2**
2. Correct, CON (of 2.)	×, (discount 2)	
3. Correct	✓	

E (4 responses)

1. Correct	✓	**3**
2. Correct	✓	
3. Correct, Wrong	✓	

F (4 responses)

1. Correct	✓	**2**
2. Correct	✓	
3. Correct CON (of 3.)	× (discount 3)	

G (5 responses)

1. Correct	✓	**3**
2. Correct	✓	
3. Correct Correct CON (of 4.)	✓ ignore ignore	

H (4 responses)

1. Correct	✓	**2**
2. Correct	×	
3. CON (of 2.) Correct	(discount 2) ✓	

I (4 responses)

1. Correct	✓	**2**
2. Correct	×	
3. Correct CON (of 2.)	✓ (discount 2)	

Question	Answer	Marks
1(a)(i)	Ba	**1**
1(a)(ii)	F	**1**
1(a)(iii)	Cs	**1**
1(b)(i)	Award 1 mark for 2 or 3 points. Award 2 marks for 4 points. • energy required / energy change ; • when one electron is removed ; • from each atom in one mole of ; • gaseous atoms ;	**2**
1(b)(ii)	*for element **B*** outer electron is removed from a higher energy level ; more shielding ; less attraction to nucleus ;	**3**
1(c)(i)	line on graph decreases from left to right	**1**
1(c)(ii)	increasing nuclear charge ; electrons in same shell ; greater attraction between nucleus and electrons ;	**3**

Question	Answer	Marks
2(a)(i)	simple molecular ; lattice / regular arrangement of C_{60} molecules ;	**2**
2(a)(ii)	C_{60} has weak intermolecular / VdW / London / dispersion / id–id forces and covalent bonds ; diamond has strong covalent bonds ; more energy required to break ; lots of covalent bonds in diamond / (complex) 3D network / giant covalent structure ;	**4**
2(b)(i)	a molecule / compound that is made up of carbon and hydrogen atoms **only**	**1**

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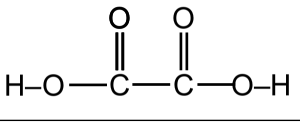
Question	Answer	Marks
2(b)(ii)	add bromine water / $Br_2(aq)$	**1**
2(b)(iii)	orange / brown to colourless	**1**
2(c)(i)	addition / hydrogenation	**1**
2(c)(ii)	$n_{C60} = 0.144 / 720 = 2.0 \times 10^{-4}$ **OR** 2.00×10^{-4}	**1**
2(c)(iii)	use of $pV = nRT$; use of $n = pV / RT$ or $\Delta n = (p1\text{-}p2)\ V / RT$; $\Delta n = (1.00 \times 10^5 - 2.21 \times 10^4).100 \times 10^{-6} / 8.31 \times 293 = 0.0032$ **OR** 0.00320 ;	**3**
2(c)(iv)	$(C_{60} : H_2 =)\ 2.00 \times 10^{-4} : 0.00320$ or 1 : 16 ; $C_{60}H_{32}$; (If 0.00240 mol hydrogen gas used answer = $2 \times 10^{-4} : 0.00240$ or 1 : 12 $C_{60}H_{24}$)	**2**
2(d)(i)	$Mg_2Si(s) + 4HCl(aq) \rightarrow SiH_4(g) + 2MgCl_2(aq)$ species **AND** balancing ; state symbols ;	**2**
2(d)(ii)	tetrahedral	**1**

Question	Answer	Marks
3(a)	$CaSO_4$ does not react with sulfuric acid **OR** the layer of $CaSO_4$ prevents the reaction	**1**
3(b)(i)	$1s^2 2s^2 2p^6 3s^2 3p^6$	**1**
3(b)(ii)	+2	**1**
3(b)(iii)		**1**
3(c)(i)	$Cl_2 + 2OH^- \rightarrow Cl^- + ClO^- + H_2O$	**1**

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Question	Answer	Marks
3(c)(ii)	species is (simultaneously) oxidised **AND** reduced **OR** a species (both) gains **AND** loses electrons **OR** the oxidation number of a species increases **AND** decreases	**1**
3(c)(iii)	–1 **AND** +5	**1**
3(d)(i)	carbon dioxide **AND** water	**1**
3(d)(ii)	reaction **1** HCN ; KCN / NaCN ; For reaction **3** Award 1 mark for identification of correct reagent and one reaction condition. Award 2 marks for identification of correct reagent and both reaction conditions. reaction **3** potassium dichromate(VI) **AND** H_2SO_4 / acid / H^+ **AND** reflux	**4**
3(d)(iii)	hydrolysis	**1**
3(d)(iv)	reducing agent	**1**
3(d)(v)	has a carbon / C / atom attached to four different groups / atoms / chains **OR** has no plane / line of symmetry / has non-super(im)posable images	**1**

Question	Answer	Marks
4(a)	ultraviolet / UV light	**1**

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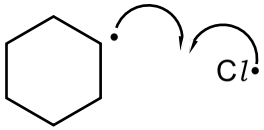
Question	Answer	Marks
4(b)	initiation ; HC*l* ; propagation ;  Award 1 mark for species. Award 1 mark for curly arrows.	**5**
4(c)	elimination	**1**
4(d)	reagents: acid **AND** potassium manganate(VII) ; conditions: hot **AND** concentrated ;	**2**

Question	Answer	Marks
5(a)	n = (100 / 1.1) × (6.5 / 100) ; so n = 5.91 so there are 6 carbon atoms ;	**2**
5(b)	102 – (6 × 12) = 30 so $C_6H_{14}O$	**1**
5(c)	$(CH_2OH)^+$	**1**
5(d)	hydroxy group because of (broad) peak at 3300 and one oxygen atom present in molecular formula	**1**

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