Cambridge International AS & A Level

**Cambridge Assessment International Education**
Cambridge International Advanced Subsidiary and Advanced Level

**CHEMISTRY** **9701/22**

Paper 2 AS Level Structured Questions **March 2018**

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 2018 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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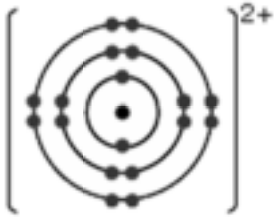
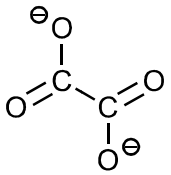
| GENERIC MARKING PRINCIPLE 5:<br><br>Marks should be awarded using the full range of marks defined in the mark scheme for the question (however; the use of the full mark range may be limited according to the quality of the candidate responses seen). |
| GENERIC MARKING PRINCIPLE 6:<br><br>Marks awarded 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) | • energy required / energy change<br>• when one electron is removed<br>• from each atom in one mole of<br>• gaseous atoms | **max 3** |
| 1(a)(ii) | *for element **B***<br>(outer electron is removed) from a higher energy level<br>more shielding<br>less attraction to nucleus | **3** |
| 1(b) | line on graph decreases **P—T**<br>increasing nuclear charge **AND** electrons in same shell<br>greater attraction between nucleus (and electrons) | **3** |

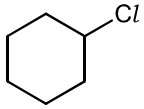
| Question | Answer | Marks |
|---|---|---|
| 2(a)(i) | simple molecular<br>regular arrangement (of $C_{60}$ molecules) | **2** |
| 2(a)(ii) | $C_{60}$ has (weak) intermolecular / VdW / London / dispersion / id–id forces (and covalent bonds)<br><br>diamond has covalent bonds<br><br>(diamond's) bonds are stronger<br><br>more energy required / lots of energy to break (covalent bonds in diamond) | **4** |
| 2(b)(i) | (a molecule / compound that is made up of)<br>carbon and hydrogen (atoms) only | **1** |
| 2(b)(ii) | add bromine (water) / $Br_2$(aq)<br><br>(brown to) colourless / decolourised | **2** |
| 2(c)(i) | addition | **1** |

| Question | Answer | Marks |
|---|---|---|
| 2(c)(ii) | ($n_{C60}$ = 0.144 / 720 =) $2 \times 10^{-4}$ | **1** |
| 2(c)(iii) | $pV = nRT$ ∴ $\Delta n = (p_1 - p_2)V / RT$<br>$\Delta n = (1.00 \times 10^5 - 2.21 \times 10^4).100 \times 10^{-6} / 8.31 \times 293$<br>= 0.00320 | **2** |
| 2(c)(iv) | ($C_{60}$:$H_2$ =) $2.00 \times 10^{-4}$ : 0.00320 or 1:16<br><br>$\underline{C_{60}}H_{32}$ | **2** |
| 2(d)(i) | giant (molecular)<br>(each Si has four) covalent (bonds) | **2** |
| 2(d)(ii) | $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6$ | **1** |
| 2(d)(iii) | $Mg_2Si(s) + 4HCl(aq) \rightarrow SiH_4(g) + 2MgCl_2(aq)$<br>species **AND** balancing<br>state symbols | **2** |
| 2(d)(iv) | tetrahedral | **1** |
| 2(d)(v) | $SiH_4 + 2O_2 \rightarrow SiO_2 + 2H_2O$ | **1** |

| Question | Answer | Marks |
|---|---|---|
| 3(a)(i) | $Ca + 2HNO_3 \rightarrow Ca(NO_3)_2 + H_2$ | **1** |
| 3(a)(ii) | $CaSO_4$ does not react (with sulfuric acid)<br><br>coating / crust / protective layer / $CaSO_4$ prevents reaction (of sulfuric acid) with calcium | **2** |

| Question | Answer | Marks |
|---|---|---|
| 3(b)(i) |  <br>dot-and-cross diagram **AND** 2+ | **1** |
| 3(b)(ii) |  <br>displayed structure of ethanedioate<br>two – charges on carboxylates **OR** 2– charge overall | **2** |
| 3(c)(i) | bleach | **1** |
| 3(c)(ii) | $Cl_2 + 2OH^- \rightarrow Cl^- + ClO^- + H_2O$ | **1** |
| 3(c)(iii) | –1 **AND** (+)5 | **1** |
| 3(c)(iv) | gains **AND** loses electrons | **1** |
| 3(d)(i) | carbon dioxide **AND** water | **1** |
| 3(d)(ii) | reaction 1: HCN ✓ NaCN ✓<br>reaction 3: • $K_2Cr_2O_7$ • $H_2SO_4$ / acid / $H^+$ • (heat under) reflux | **4** |

| Question | Answer | Marks |
|---|---|---|
| 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<br>**OR**<br>has no plane / line of symmetry / has non-superimposable images | **1** |

| Question | Answer | Marks |
|---|---|---|
| 4(a)(i) | ultraviolet / UV light | **1** |
| 4(a)(ii) | initiation<br>HC*l*<br>propagation<br>  | **4** |
| 4(b) | elimination | **1** |
| 4(c)(i) | acidified **AND** $KMnO_4$<br>hot **AND** c(oncentrated) | **2** |
| 4(c)(ii) | cyclohexene would have absorption at 1500–1680 ($cm^{-1}$) because of C=C (and adipic acid would not)<br>cyclohexene would have absorption at 3000–3100 ($cm^{-1}$) because of =C—H/C—H in alkene (and adipic acid would not)<br>adipic acid would have absorption at 2500–3000 ($cm^{-1}$) because of O—H/$CO_2$—H (and cyclohexene would not)<br>adipic acid would have absorption at 1040–1300 ($cm^{-1}$) because of C—O (and cyclohexene would not)<br>adipic acid would have absorption at 1640–1750 ($cm^{-1}$) because of C=O (and cyclohexene would not) | **max 3** |