Cambridge International AS & A Level

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

**CHEMISTRY** **9701/23**

Paper 2 AS Level Structured Questions **May/June 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.

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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.

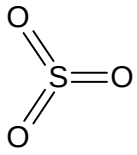
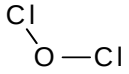
GENERIC MARKING PRINCIPLE 4:

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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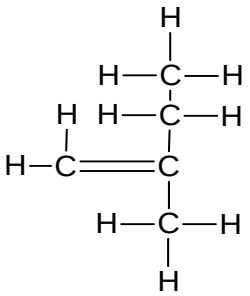
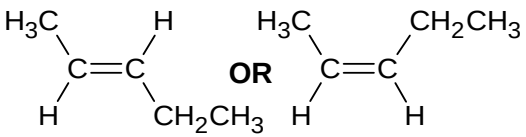
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|---|
| GENERIC MARKING PRINCIPLE 5:<br><br>Marks should be awarded using the full range of marks defined in the mark scheme for the question (however; the use of the full mark range may be limited according to the quality of the candidate responses 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. |

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| Question | Answer | Marks |
|---|---|---|
| 1(a) |  <br>trigonal planar non-linear/bent/V-shaped/angular | **4** |
| 1(b)(i) | stronger attraction for $O^{2-}$ / stronger ionic bonding / more energy needed to overcome ionic bonding / separate ions | **1** |
| | charge density of magnesium (ion) is greater (than sodium ion) ***ora*** | **1** |
| 1(b)(ii) | Either:<br><br>M1 $SiO_2$ has a giant (covalent) structure / giant molecular<br>M2 Covalent bonds (much) stronger than VdW / id-id / IMFs in $SO_3$<br><br>OR<br><br>M1 $SO_3$ has a (simple) molecular structure / (simple) molecule.<br>M2 VdW / id-id / IMFs M2 IMF's are (much) weaker than covalent bonds (broken in $SiO_2$)<br><br>OR<br><br>M1 Covalent bonds are broken in $SiO_2$ AND VdW / id-id / IMFs in $SO_3$<br>M2 Covalent bonds are stronger (than VdW / id-id / IMFs) | **2** |
| 1(c)(i) | molecules / particles / reacting species are closer together | **1** |
| | so frequency of collisions increases | **1** |
| | few(er) moles on right | **1** |
| | so (equilibrium) reaction shifts right / towards products / (as pressure increases to oppose the change) | **1** |

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| Question | Answer | Marks |
|---|---|---|
| 1(c)(ii) | Decreasing reactant concentrations (at different time intervals / as reaction progresses) | **1** |
| | So rate decreases OR change in concentration ÷ time taken decreases | **1** |
| 1(c)(iii) | (line becomes horizontal when) forward and reverse rates equal / equilibrium established | **1** |
| 1(c)(iv) | 2:1 ratio in equation / $SO_2$ used up more quickly (than $O_2$) / 2 × $SO_2$ react for every 1 × $O_2$ | **1** |
| 1(d)(i) | $K_c = \dfrac{[SO_3]^2}{[SO_2]^2 \times [O_2]}$ | **1** |
| 1(d)(ii) | $SO_2$ = 0.02 (mol) | **1** |
| | $O_2$ = 1.01 (mol) | **1** |
| 1(d)(iii) | $K_c = \dfrac{(1.98/40)^2}{(0.02/40)^2 (1.01/40)}$ M1<br>= 3.88 / 3.882 × $10^5$ M2<br>Units = $dm^3\ mol^{-1}$ / $mol^{-1}\ dm^3$ M3 | **3** |

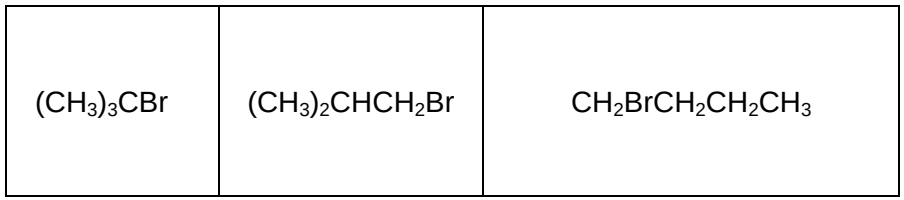
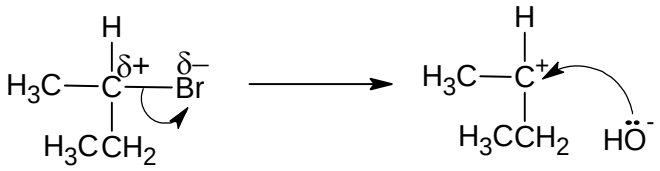
| Question | Answer | Marks |
|---|---|---|
| 2(a)(i) | (molecules / isomers with) the same molecular formula / same number of atoms of each element | **1** |
| | different structural formulae / different structures | **1** |
| 2(a)(ii) | (Molecules / isomers) with the same (molecular and) structural formula | **1** |
| | different arrangement of atoms in space / different spatial arrangement of atoms. | **1** |
| 2(b)(i) | two Hs on one of the C=C carbons / terminal C / C–1 | **1** |
| | no chiral C / no C with 4 different groups / atoms / chains attached has a super(im)posable mirror image | **1** |
| 2(b)(ii) |  | **1** |
| | 2-methylbut-1-ene | **1** |
| 2(b)(iii) | structure<br> | **1** |
| | trans–pent–2–ene or<br>or *E*– | cis–pent–2–ene<br>or *Z*– | **1** |

<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>3(a)(i)</td><td>(volatility) decreases</td><td>1</td></tr>
<tr><td rowspan="2">3(a)(ii)</td><td>increasing numbers / more of electrons (in molecules)</td><td>1</td></tr>
<tr><td>increased strength of id-id / VdW / IMFs</td><td>1</td></tr>
<tr><td>3(b)</td><td>$Cl_2 + 2NaI \rightarrow 2NaCl + I_2$</td><td>1</td></tr>
<tr><td>3(c)(i)</td><td>
<table>
<tr><td></td><td>$NaI(aq) + AgNO_3(aq)$</td><td>$NaCl(aq) + AgNO_3(aq)$</td></tr>
<tr><td>colour of ppt</td><td>yellow</td><td>white</td></tr>
<tr><td>name of ppt</td><td>silver iodide</td><td>silver chloride</td></tr>
<tr><td>effect of addition of aqueous ammonia to the precipitate</td><td>No (visible) change</td><td>dissolves / soluble</td></tr>
</table>
</td><td>3</td></tr>
<tr><td>3(c)(ii)</td><td>$Ag^+(aq) + I^-(aq) \rightarrow AgI(s)$</td><td>1</td></tr>
</table>

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| Question | Answer | Marks |
|---|---|---|
| 3(d) | M1 sulfuric acid acts as an acid with NaCl (and NaBr)<br>OR<br>$NaCl + H_2SO_4 \rightarrow NaHSO_4 + HCl$<br>OR<br>$2NaCl + H_2SO_4 \rightarrow Na_2SO_4 + 2HCl$ | **1** |
| | sulfuric acid acts as an oxidising agent with NaI / I<br>OR<br>NaI is a reducing agent | **1** |
| | $I^-$ more powerful reducing agent than $Cl^-$<br>OR<br>sulfuric acid can oxidise $I^-$ but not $Cl^-$<br>OR<br>sulfuric acid is a stronger oxidising agent than iodide ions<br>OR<br>sulfuric acid is not as strong an oxidising agent than chloride ions | **1** |
| 3(e)(i) | (Species that) gains <u>electrons</u> / <u>electron</u> acceptor | **1** |
| 3(e)(ii) | $Cl_2 + H_2O \rightarrow HCl + HClO$ | **1** |
| 3(e)(iii) | $3Cl_2 + 6NaOH \rightarrow 5NaCl + NaClO_3 + 3H_2O$ | **1** |
| | 0 to –1 (+)5 AND chlorine has been oxidised and reduced. | **1** |

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| Question | Answer | Marks |
|---|---|---|
| 4(a)(i) | 2-bromobutane | **1** |
| 4(a)(ii) | ketone | **1** |
| 4(b) | <br>3 correct = 2 marks<br>2 correct = 1 mark | **2** |
| 4(c)(i) | S = substitution<br>N = nucleophilic | **1** |
| 4(c)(ii) | <br>M1 = dipole and curly arrow<br>M2 = intermediate carbocation IGNORE $CH_2CH_3$ shown as $C_2H_5$<br>M3 = $OH^-$ with lone pair and curly arrow from lone pair to the 'C' | **3** |
| 4(d) | • $C_4H_9Cl$ slower (than $C_4H_9Br$)<br>• $C_4H_9I$ faster (than $C_4H_9Br$)<br>• C–Cl bond stronger than C–Br OR C–Cl 340 C–Br 280<br>• C–I bond weaker then C–Br OR C–Br 280 C–I 240<br>1 mark for each point, max 3 | **3** |

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| Question | Answer | Marks |
|---|---|---|
| 4(e) | ethanolic (instead of aqueous) | **1** |
| | hotter/higher temperature (heat under) reflux | **1** |

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