GCE

Chemistry B (Salters)

Unit F332: Chemistry of Natural Resources

Advanced Subsidiary GCE

Mark Scheme for June 2017
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This mark scheme is published as an aid to teachers and students, to indicate the requirements of the examination. It shows the basis on which marks were awarded by examiners. It does not indicate the details of the discussions which took place at an examiners’ meeting before marking commenced.

All examiners are instructed that alternative correct answers and unexpected approaches in candidates’ scripts must be given marks that fairly reflect the relevant knowledge and skills demonstrated.

Mark schemes should be read in conjunction with the published question papers and the report on the examination.

OCR will not enter into any discussion or correspondence in connection with this mark scheme.

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### Annotations

<table>
<thead>
<tr>
<th>Annotation</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>DO NOT ALLOW</strong></td>
<td>Answers which are not worthy of credit</td>
</tr>
<tr>
<td><strong>IGNORE</strong></td>
<td>Statements which are irrelevant</td>
</tr>
<tr>
<td><strong>ALLOW</strong></td>
<td>Answers that can be accepted</td>
</tr>
<tr>
<td>()</td>
<td>Words which are not essential to gain credit</td>
</tr>
<tr>
<td>___</td>
<td>Underlined words must be present in answer to score a mark</td>
</tr>
<tr>
<td><strong>ECF</strong></td>
<td>Error carried forward</td>
</tr>
<tr>
<td><strong>AW</strong></td>
<td>Alternative wording</td>
</tr>
<tr>
<td><strong>ORA</strong></td>
<td>Or reverse argument</td>
</tr>
</tbody>
</table>
INTRODUCTION

Your first task as an Examiner is to become thoroughly familiar with the material on which the examination depends. This material includes:

- the specification, especially the assessment objectives
- the question paper
- the mark scheme.

You should ensure that you have copies of these materials.

You should ensure also that you are familiar with the administrative procedures related to the marking process. These are set out in the OCR booklet Instructions for Examiners. If you are examining for the first time, please read carefully Appendix 5 Introduction to Script Marking: Notes for New Examiners.

Please ask for help or guidance whenever you need it. Your first point of contact is your Team Leader.
<table>
<thead>
<tr>
<th>Question</th>
<th>Answer</th>
<th>Marks</th>
<th>Guidance</th>
</tr>
</thead>
<tbody>
<tr>
<td>1ai</td>
<td>UV/ultraviolet</td>
<td>1</td>
<td>ALLOW visible</td>
</tr>
<tr>
<td>1aii</td>
<td>Infrared/IR (radiation)</td>
<td>1</td>
<td>IGNORE wavelength or frequency</td>
</tr>
<tr>
<td>1aiii</td>
<td>change in vibrational energy state/their bonds vibrate (more)</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>1aiv</td>
<td>EITHER energy is transferred to other molecules by collisions, √ thus increasing their kinetic energy (and raising the temperature) √ OR molecules also (re-)emit (some of the absorbed) IR (in all directions) √ (some of which) heats up the Earth √</td>
<td>2</td>
<td>ALLOW for 1 mark Increase in vibrational energy increases kinetic energy (of molecules) AW ALLOW a mixed answer here – eg molecules emit IR increasing kinetic energy of (surrounding) molecules (and raising temp) Last marking point must be in context of IR</td>
</tr>
<tr>
<td>1av</td>
<td>Energy/heat is lost/ emitted √ This balances (AW) the greenhouse effect/ heat gain √</td>
<td>2</td>
<td>ALLOW for one mark, amount of IR absorbed is constant/concentration of greenhouse gas is constant</td>
</tr>
<tr>
<td>1b</td>
<td>one from: √ burn/use less fossil fuels scrub (AW) CO₂ from chimneys</td>
<td>1</td>
<td>answers must be ways of reducing emissions, not of reducing the amount of CO₂ present.</td>
</tr>
<tr>
<td>1c</td>
<td>double covalent bonds (in simple molecule) √ polarised Cδ+–Oδ− √ no overall dipole/dipoles cancel out/ partial charges cancel out/ non polar/centres positive and negative charges co-incide √ instantaneous dipole–induced dipole √</td>
<td>4</td>
<td>For mp1 allow C=O in diagram if covalent also stated Polar bond can be shown in diagram or described QWC ‘instantaneous dipole-induced dipole’ must be spelled correctly to score 4th marking point.</td>
</tr>
<tr>
<td>1di</td>
<td>homolytic</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>1dii</td>
<td>FIRST CHECK ANSWER ON ANSWER LINE If answer = 706 award 4 marks E = 6.63 x 10^{-34} x 1.77. x 10^{15} √ x 6.02 x 10^{23} and divide by 1000 √ = 706(.453...) √ 706 (3 sf) √</td>
<td>4</td>
<td>allow ecf throughout mp1 can be scored later in calculation Award mp4 for any correctly evaluated calculation using at least 2 of the terms in the question that has been correctly rounded to 3 sf</td>
</tr>
<tr>
<td>1diii</td>
<td>+4 √</td>
<td>2</td>
<td>Award 1 mark if all correct but + sign omitted or placed after the number</td>
</tr>
</tbody>
</table>
| 2ai       | yellow precipitate √  
|           | Ag⁺(aq) + I⁻(aq) ---> AgI(s)  
|           | equation √  state symbols √ | 19 | Both words required for the mark. ALLOW ppt  
|           | (large surplus of) white ppt will mask yellow AW √ | 3 | (aq) (aq) (s) for state symbol mark even if equation wrong |
| 2aii      | Add chlorine (solution) √  
|           | Brown colour AND purple in hexane/ organic solvent √ | 1 | ALLOW add bromine (solution)  
|           | solution gets browner  
|           | ALLOW add conc. NH₃ to 2ai √  
|           | ABr and AgCl dissolve to leave yellow ppt (of AgI) √ | | |
| 2b        | Brown colour | 1 | DO NOT ALLOW other colours  
|           | IGNORE precipitate | | |
| 2c        | Brown colour | 2 | Second mark needs correct evaluation |
| 2di       | (19.6 x 1.5 x 10⁻⁴ /1000)√ × 0.5√ = 1.47 x 10⁻⁶ mol | 2 | ALLOW ecf from 2di  
|           | mol Iodate in 25 = 1.47 x 10⁻⁶ /3 or 4.9 x 10⁻⁷ √  
|           | mol in 1000 = (4.9 x 10⁻⁷ x 40) = 1.96 x 10⁻⁵ √ | | |
| 2dii      | mass = 1.96 x 10⁻⁵ x 214 or 4.19(44) x 10⁻³ g √  
|           | ppm = 41.9 ppm √ | 2 | ALLOW ecf from 2dii  
|           | For mp2 ALLOW ecf for incorrect RFM | | |
| 2diii     | (primary) amine √  
|           | carboxyl/carboxylic acid √  
|           | ether √ | 2 | ALLOW iodide reacts to form Iodine  
|           | ALLOW “It” for iodide | | |
| 2e        | the iodide is oxidised by oxygen (in the air) √  
|           | iodine is volatile/vaporises/evaporates √ | 2 | | |
| 2fi       | (primary) amine √  
|           | carboxyl/carboxylic acid √  
<p>|           | ether √ | 3 | | |</p>
<table>
<thead>
<tr>
<th>2fii</th>
<th>109 √</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>four pairs/groups of electrons or areas of electron density √</td>
</tr>
<tr>
<td></td>
<td>(electrons) repel √</td>
</tr>
<tr>
<td></td>
<td>get as far away as possible √</td>
</tr>
</tbody>
</table>

**ALLOW 104 – 110**

**QWC** first marking point depends on second being correct

**IGNORE** descriptions of shape

**ALLOW** 4 regions of **negative** charge

must be in the context of ‘electrons repel’

**IGNORE** ‘repel as much as possible’

‘minimise repulsion’ scores last two marks

| 4 | 22 |
### Question 3

#### 3ai
- $\Delta \sqrt{\text{cyclopropane}} \sqrt{\text{}}$
- 2 marks
- Mark independently
- **ALLOW** any unambiguous formula

#### 3a(ii)
- One end of double bond (AW) has two hydrogens/two of same group
- 1 mark
- **DO NOT ALLOW** functional group
- **ALLOW** Does not have 2 different groups on each C of C=C

#### 3b(i)
- C=C 1620 – 1680 (cm$^{-1}$) OR C–H 3000 – 3100 (cm$^{-1}$)
- 1 mark

#### 3b(ii)
- The fingerprint region/region below 1500/1000 can be compared with a database AW
- 2 marks

#### 3c(i)
- $\text{C}_3\text{H}_6\text{O} \rightarrow \text{C}_3\text{H}_6 + \text{H}_2\text{O}$
- 1 mark
- Must be molecular formula for the alcohol

#### 3c(ii)
- Elimination
- 1 mark

#### 3d(i)
- Addition condensation substitution oxidation all three $\sqrt{\text{}}$ two $\sqrt{\text{}}$
- 2 marks

#### 3d(ii)
- $\text{CH}_3\text{CHBrCH}_3$ **AND** 2-bromopropane
- 1 mark
- **ALLOW** any unambiguous formula

#### 3d(iii)
- Bromine must be on centre carbon since C=O on centre carbon/
- Bromine must be on centre carbon since OH on centre carbon (of alcohol / ketone is produced from secondary alcohol (AW))
- 1 mark
- Curly arrows must start (when extended back) to a bond or negative charge (or lone pair) on Br.
- They must end pointing to atom or (where appropriate) the bond between atoms.
- Mp1 and mp3 can still be awarded if mechanism is for 1-bromopropane

#### 3d(iv)
- Curly arrow on HBr and from C=C to H
- Secondary carbocation
- Attack by Br$^-$ to form product
- 3 marks

#### 3d(v)
- Propan-2-ol
- 1 mark
- **ALLOW** propan-1-ol as ecf if 1-bromopropane given as answer to 3d(ii)

#### 3d(vi)
- Secondary
- 1 mark
- **ALLOW** primary as ecf if 1-bromopropane given as answer to 3d(ii)

#### 3d(vii)
- Ketone
- 1 mark

#### 3e(i)
- Addition
- 1 mark
- **DO NOT ALLOW** additional
<table>
<thead>
<tr>
<th>Question</th>
<th>Mark Scheme</th>
</tr>
</thead>
<tbody>
<tr>
<td>3ei</td>
<td><img src="H3C-C-C-H" alt="Structure" /></td>
</tr>
<tr>
<td>3eii</td>
<td>Softens/melts when heated/warmed</td>
</tr>
<tr>
<td>4a</td>
<td>rate faster √&lt;br&gt;more frequent collisions with energy greater than activation enthalpy √&lt;br&gt;Lower yield (AW) √&lt;br&gt;(Forward reaction is) exothermic ORA √</td>
</tr>
<tr>
<td>4bi</td>
<td>Increased pressure more yield (ORA) √&lt;br&gt;Fewer moles/molecules/particles on the right/fewer product molecules √</td>
</tr>
<tr>
<td>4bii</td>
<td>cost and danger AW √</td>
</tr>
<tr>
<td>4ci</td>
<td>ethanal – distillation √&lt;br&gt;ethanoic acid – (heat under) reflux (then distill) √</td>
</tr>
<tr>
<td>4cii</td>
<td>![Structures](H3C-C-O-H, H-C-C=O, H-C-C=O)</td>
</tr>
<tr>
<td>4ciii</td>
<td>instantaneous dipole-induced dipole √&lt;br&gt;hydrogen bonds √&lt;br&gt;Oδ--Hδ+ √&lt;----:O √</td>
</tr>
</tbody>
</table>
| 4civ | Ethanol and ethanoic acid have hydrogen bonds ✓ permanent dipole-permanent dipole bonds in ethanal ✓ so more energy is required to break hydrogen bonds (than other intermolecular bonds) ORA ✓ | 3 Mark independently
**IGNORE** hydrogen bonds are stronger | 18 |
5a  chlorine atoms catalysing the breakdown of ozone AW  

5b  

\[ \text{2Co}^{2+} + \text{H}_2\text{O}_2 + \text{2H}^+ \rightarrow \text{2Co}^{3+} + \text{2H}_2\text{O} \] 

\[ \text{C}_6\text{H}_6\text{O}_6^{2-} + \text{6Co}^{3+} + \text{2H}_2\text{O} \rightarrow \text{6H}^+ + \text{6Co}^{2+} + \text{2CO}_2 + \text{2HCOO}^- \] 

\[ \text{3H}_2\text{O}_2 + \text{C}_4\text{H}_6\text{O}_6^{2-} \rightarrow \text{4H}_2\text{O} + \text{2CO}_2 + \text{2HCOO}^- \] 

5ci  Two negative ions repel AND require a large activation enthalpy (to react) √

5cii  

\[ \text{enthalpy} \] 

enthalpy arrow and reactants and prods √ 

downward arrow labelled ∆H √ 

intermediate and curves √ 

upward arrows both labelled \( E_a \) √

5ciii  

\[ \text{1s}^2 \text{2s}^2 \text{2p}^6 \text{3s}^2 \text{3p}^6 \text{3d}^5 \] 

1  ALLOW including 4s^5

5civ  Fe^{3+} oxidises I^- then Fe^{2+} reduces S_2O_8^{2-} √

1  ALLOW in words or by equations

ALLOW 'reacts with' for oxidises/reduces
| 5d | (ozone) screens/filters/ removes/ absorbs/ blocks/ shields (AW) high energy/high frequency uv/ uvB/uvC OR prevents high energy/high frequency uv/ uvB/uvC getting through OR protects us from high energy/high frequency uv/ uvB/uvC √ that causes skin cancer/mutations/damage √ | 2 | ALLOW damage to DNA in plants and/or animals ALLOW damages immune system/damage to eyes |
| 5ei | hydrofluorocarbon √ | 1 | ALLOW gaps and minor spelling errors |
| 5eii | C–F bonds do not break (in stratosphere) OR (HFCs) do not release F atoms (in stratosphere) √ (HFCs) break down in the troposphere √ | 2 | |
| 5eiii | (HFCs) are greenhouse gases | 1 | IGNORE photochemical smog / breakdown to produce greenhouse gases |
| 5fi | unpaired electron (s) √ | 2 | IGNORE ‘lone’/’single’ |
| 5fii | NO + O₃ ---→ NO₂ + O₂ NO₂ + O ---→ NO + O₂ √ | 1 | |

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