



**GCE**

**Chemistry A**

**H032/02:** Depth in chemistry

Advanced Subsidiary GCE

**Mark Scheme for June 2019**



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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.

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Annotations available in RM Assessor

| Annotation  | Meaning                                |
|---|--|
|    | Correct response                       |
|    | Incorrect response                     |
|    | Omission mark                          |
|    | Benefit of doubt given                 |
|    | Contradiction                          |
|    | Rounding error                         |
|    | Error in number of significant figures |
|    | Error carried forward                  |
|    | Level 1                                |
|    | Level 2                                |
|    | Level 3                                |
|   | Benefit of doubt not given             |
|  | Noted but no credit given              |
|  | Ignore                                 |



Abbreviations, annotations and conventions used in the detailed Mark Scheme (to include abbreviations and subject-specific conventions).

| <b>Annotation</b>   | <b>Meaning</b>   |
|---------------------|--|
| <b>DO NOT ALLOW</b> | Answers which are not worthy of credit                     |
| <b>IGNORE</b>       | Statements which are irrelevant                            |
| <b>ALLOW</b>        | Answers that can be accepted                               |
| ( )                 | Words which are not essential to gain credit               |
| —                   | Underlined words must be present in answer to score a mark |
| <b>ECF</b>          | Error carried forward                                      |
| <b>AW</b>           | Alternative wording  |
| <b>ORA</b>          | Or reverse argument  |



## Subject-specific Marking Instructions

### 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.



| Question |     |      | Answer   | Marks | AO element  | Guidance   |
|----------|-----|------|--|-------|-------------|--|
| 1        | (a) | (i)  | (Weighted) mean/average mass of an <b>atom</b> ✓<br>compared with 1/12th mass of carbon-12<br><b>OR</b> compared with mass of carbon-12 which is 12 ✓  | 2     | AO1.1<br>×2 | <b>DO NOT ALLOW</b> mean mass of an element<br><i>i.e.</i> 'atom' essential<br><br><b>Both marks available based on mole:</b><br><b>ALLOW</b> mass of <b>1 mole</b> of atoms ✓<br>compared to 1/12th <b>1 mole</b> /12 g of carbon-12 ✓<br><br><b>ALLOW</b> <u>mass of one mole of atoms</u> ✓<br>1/12th mass of one mole/12 g of carbon-12 ✓  |
|          |     | (ii) | <b>Use of isotope data</b><br>Use of $87 \times 6.9$ <b>AND</b> $88 \times 82.9$ <b>AND</b> 10.2 anywhere ✓<br><br><b>Calculation of isotopic mass</b><br>$\frac{(100 \times 87.73) - (87 \times 6.9) - (88 \times 82.9)}{10.2} = 86 \text{ OR } 86.03 \checkmark$ | 2     | AO1.2<br>×2 | <b>ALLOW</b> $877.5 = 10.2A$<br><br><b>ALLOW</b> $87.73 = \frac{(A \times 10.2) + 600.3 + 7295.2}{100}$<br><br><b>ALLOW</b> $\frac{8773 - 600.3 - 7295.2}{10.2} = 86.03$<br><br><b>ALLOW</b> $\frac{87.73 - 78.955}{0.102}$ <b>OR</b> $\frac{8.775}{0.102} = 86$ <b>OR</b> 86.03<br><br><b>DO NOT ALLOW</b> Sr-86 with no working/justification<br><br><b>ALLOW</b> any unambiguous representation |





| Question |          | Answer  | Marks | AO element               | Guidance  |
|----------|----------|---|-------|--------------------------|---|
|          | (c) (ii) | Two points (✓✓) from<br>With calcium:<br>1. less vigorous fizzing/bubbling/effervescence<br>2. dissolves more slowly/slower reaction<br>3. solution has a lower pH/less alkaline<br>4. precipitate forms/less soluble   | 2     | AO2.3<br>×2              | <b>IGNORE</b> gives out less/more heat, less reactive, less gas   |
| 1        | (d) (i)  | <b>FIRST CHECK THE ANSWER ON ANSWER LINE</b><br><b>If answer = 5.8 award 3 marks</b><br>-----<br>$n(\text{SrCl}_2) = \frac{1.62}{158.6} = 0.0102\dots\dots (\text{mol}) \checkmark$<br>$n(\text{H}_2\text{O}) = \frac{1.07}{18} = 0.0594\dots\dots (\text{mol}) \checkmark$<br>$x = \text{SrCl}_2 : \text{H}_2\text{O} = \frac{0.0594\dots\dots}{0.0102\dots\dots}$<br>$= 5.8 \checkmark$ | 3     | AO3.1<br>×2<br><br>AO3.2 | <b>Calculator:</b> 0.01021437579<br><br><b>Calculator:</b> 0.05944444444<br><br><b>ALLOW ECF</b> from $n(\text{SrCl}_2)$ and/or $n(\text{H}_2\text{O})$<br><br>Answer must be to <b>TWO</b> significant figures<br><br><b>ALLOW</b> 2 marks for 5.83 (answer must be to 2 SF) |



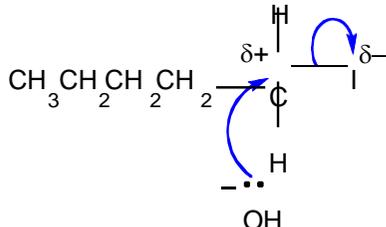
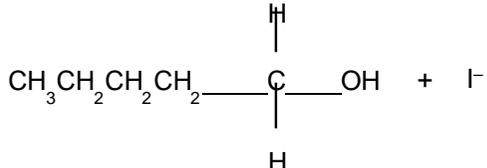
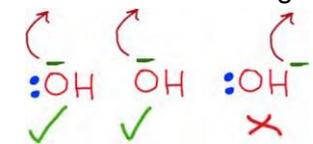
| Question |       | Answer   | Marks     | AO element  | Guidance   |
|----------|-------|--|-----------|-------------|--|
|          | (ii)  | To make sure all the water had been removed ✓  | 1         | AO3.4       | <b>IGNORE</b> just 'to weigh to constant mass'   |
|          | (iii) | Use balance that weighs to 3/more decimal places ✓<br><br>Use a larger mass (of hydrated strontium chloride) ✓ | 2         | AO3.4<br>×2 | <b>ALLOW</b> more precise/more accurate/ more sensitive/higher resolution/smaller division/weigh to 0.001<br><br><b>IGNORE</b> 'less error/smaller interval balance'<br><br><b>IGNORE</b> any reference to lid on crucible (water can't escape)<br><br><b>IGNORE</b> 'weigh straight after heating'<br><br><b>IGNORE</b> idea of repeating the experiment/ taking an average/ getting concordant results /larger sample size, etc. |
|          |       | <b>Total</b>   | <b>18</b> |             |  |





| Question |     | Answer  | Marks     | AO element  | Guidance   |
|----------|-----|---|-----------|-------------|--|
| 2        | (b) | <p><b>FIRST CHECK THE ANSWER ON ANSWER LINE</b><br/> <b>If answer = 38.5 cm<sup>3</sup> award 3 marks</b></p> <p>-----</p> $n(\text{Mg}(\text{NO}_3)_2) = \frac{\quad}{148.3} = 0.0337\text{..... (mol)} \checkmark$ $n(\text{HNO}_3) = 2 \times 0.0337 \text{ .....} = 0.0674\text{..... (mol)} \checkmark$ $\text{volume} = 0.0674\text{.....} \times \frac{1000}{1.75} = 38.5 \text{ (cm}^3\text{)} \checkmark$ <p style="text-align: right;"><b>3 SF required</b></p> | 3         | AO2.8<br>×3 | <p><b>Calculator:</b> 0.03371544167</p> <p><b>ALLOW ECF</b> from <math>n(\text{Mg}(\text{NO}_3)_2)</math><br/> <b>Calculator:</b> 0.06743088334</p> <p><b>ALLOW ECF</b> from <math>n(\text{HNO}_3)</math></p>  |
|          | (c) | <p>Element <b>oxidised:</b> Oxygen/O<br/> Change from: -2 to 0 ✓</p> <p>Element <b>reduced:</b> Nitrogen/N:<br/> Change form + 5 to +4 ✓</p>  | 2         | AO2.2<br>×2 | <p><b>MAX 1 mark</b> if no '+' sign for oxidation number</p> <p><b>ALLOW 2-</b></p> <p><b>ALLOW 5+ AND 4+</b></p> <p><b>ALLOW O<sub>2</sub></b> for oxygen</p> <p><b>ALLOW 1 mark</b> for all oxidation numbers correct,<br/> but oxidised and reduced the wrong way around</p> <p><b>IGNORE</b> numbers around equation<br/> <i>i.e. treat as rough working</i></p> |
|          |     | <b>Total</b>  | <b>11</b> |             |  |



| Question  | Answer  | Marks | AO element  | Guidance  |
|-----------|---|-------|-------------|---|
| 3 (a) (i) | <p>Curly arrow from HO<sup>-</sup> to carbon atom of C–I bond ✓</p> <p>Dipole shown on C–I bond, C<sup>δ+</sup> and I<sup>δ-</sup><br/><b>AND</b><br/>curly arrow from C–I bond to I atom ✓</p>  <p><b>IGNORE</b> presence of Na<sup>+</sup> but OH<sup>-</sup> needed<br/>i.e. Na<sup>+</sup>OH<sup>-</sup> can be allowed if the criteria are met</p> <p>-----</p> <p>Correct organic product <b>AND</b> I<sup>-</sup> ✓</p>  <p><b>IGNORE</b> presence of Na<sup>+</sup> but I<sup>-</sup> needed<br/>i.e. Na<sup>+</sup>I<sup>-</sup> can be allowed BUT NaI does not show I<sup>-</sup></p> | 3     | AO2.5<br>×3 | <p><b>ANNOTATE ANSWER WITH TICKS AND CROSSES</b><br/><b>NOTE:</b> curly arrows can be straight, snake-like, etc.<br/>but <b>NOT</b> double headed or half headed arrows</p> <p><b>1st curly arrow</b> must</p> <ul style="list-style-type: none"> <li>go to the C of C–I</li> </ul> <p><b>AND</b></p> <ul style="list-style-type: none"> <li>start from, <b>OR</b> be traced back to <b>any point across width</b> of lone pair on O of OH<sup>-</sup></li> </ul>  <ul style="list-style-type: none"> <li><b>OR</b> start from – charge <b>on O</b> of –OH ion</li> </ul>  <p>(Lone pair <b>NOT</b> needed if curly arrow shown from O<sup>-</sup>)</p> <p><b>2nd curly arrow</b> must start from, <b>OR</b> be traced back to, <b>any part of</b> C–I bond and go to I</p>  |
|           | (ii) <b>Time for precipitate</b> to appear ✓  | 1     | AO3.3       | Time <b>AND</b> precipitate required<br><i>Question asks for measurement</i>  |



|   |     |       |   |           |             |   |
|---|-----|-------|---|-----------|-------------|---|
| 3 | (a) | (iii) | <p>C–I bond is weaker (than C–Br bond)<br/><b>OR</b><br/>C–I bond has a lower bond enthalpy (than C–Br bond) ✓</p> <p>Carbon – halogen <b>bond breaks</b> ✓</p>   | 2         | AO3.2       | <p><b>For 2 marks,</b><br/><b>ALLOW</b> C–I is broken more easily (than C–Br) as the bond is weaker</p> <p>There must be a <b>comparison</b> between C–Br and C–I bonds</p>   |
|   | (b) | (i)   | Molecular mass ✓  | 1         | AO1.1       | <p><b>IGNORE</b> 'relative'<br/><b>IGNORE</b> 'molecular ion' alone, answer must relate to <b>mass</b></p> <p><b>ALLOW</b> <math>M_r</math> / molar mass</p>  |
|   |     | (ii)  | <p>Y: <math>\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2</math> ✓</p> <p>Z: <math>\text{CH}_3\text{CH}_2\text{CH}_2^+</math> ✓</p> <p><i>If positive charge is missing but the structures of Y AND Z are correct, award one mark</i></p> | 2         | AO3.2<br>×2 | <p><b>FOR ONE MARK</b><br/><b>ALLOW</b> <math>\text{C}_5\text{H}_{11}^+</math> <b>AND</b> <math>\text{C}_3\text{H}_7^+</math></p> <p><b>ALLOW</b> any combination of skeletal <b>OR</b> structural <b>OR</b> displayed formula as long as unambiguous</p> |
|   | (c) | (i)   | <pre>       H       CH3      H       H                                 H — C — C — C — C — H                                       H       I       H       H           </pre> <p style="text-align: right;">✓</p>                                   | 1         | AO1.1       | <b>ALLOW</b> any combination of skeletal <b>OR</b> structural <b>OR</b> displayed formula as long as unambiguous  |
|   |     | (ii)  | <p><b>Similarity</b><br/>Both have a peak at (<math>m/z =</math>) 198 (X) <b>OR</b> 71 (Y) <b>OR</b> 29 ✓</p> <p><b>Difference</b><br/>2-iodo-2-methylbutane has <b>no</b> peak at (<math>m/z =</math>) 43 (Z) ✓</p>                                | 2         | AO3.2<br>×2 | <p><b>ALLOW</b> same molecular ion peak / <math>M_r</math></p> <p><b>IGNORE</b> statements where no specific ion peak is suggested e.g. "different ion peaks"</p>   |
|   |     |       | <b>Total</b>  | <b>12</b> |             |   |



| Question |     | Answer  | Marks | AO element  | Guidance   |
|----------|-----|---|-------|-------------|--|
| 4        | (a) | <p><b>FIRST CHECK THE ANSWER ON ANSWER LINE</b><br/> <b>If answer = 60 cm<sup>3</sup> award 3 marks</b></p> <hr/> $n(\text{HCl}) = \frac{50.0}{1000} \times 0.100 = 5.00 \times 10^{-3} \text{ (mol) } \checkmark$ $n(\text{H}_2) = \frac{5.00 \times 10^{-3}}{2} = 2.50 \times 10^{-3} \text{ (mol) } \checkmark$ $\text{Volume} = 2.5(0) \times 10^{-3} \times 24.0 \times 1000 = 60(.0) \text{ cm}^3 \checkmark$ | 3     | AO2.6<br>×3 | <p><b>ALLOW</b> 120 cm<sup>3</sup> for 2 marks (no ÷ 2)<br/> <b>ALLOW</b> 240 cm<sup>3</sup> for 2 marks (× 2 not ÷ 2)</p> <p><b>IGNORE</b> absence of trailing zeroes, e.g. for 0.100, <b>ALLOW</b> 0.1</p> <p><b>ALLOW ECF</b> from <math>n(\text{HCl})</math></p> <p><b>ALLOW ECF</b> from <math>n(\text{HCl})</math> and/or <math>n(\text{H}_2)</math></p> |
|          | (b) | (i)   | 1     | AO2.4<br>×1 | <p><b>ALLOW</b> Time (s) <b>OR</b> Time in s<br/> <b>ALLOW</b> seconds <b>OR</b> sec <b>OR</b> secs</p> <p>Tolerance ± 1 small square</p> <p>Point at 0,0 <b>NOT</b> required<br/> <b>ALLOW</b> up to 3 plotting errors</p>  |
|          |     | (ii)  | 1     | AO2.4<br>×1 | <p><b>ALLOW</b> one more anomalous point <b>NOT</b> on the curve drawn in (iii)</p>  |
|          |     | (iii)   | 1     | AO3.1       |  |
|          | (c) | <p>Initial slope is steeper<br/> <b>AND</b> curve levels off at an earlier time ✓</p> <p><b>Same</b> volume of gas produced (58 cm<sup>3</sup>) ✓</p>   | 2     | AO2.8<br>×2 | <p>Tolerance ± 1 small square</p>  |



| Question     |     | Answer  | Marks     | AO element  | Guidance   |
|--------------|-----|---|-----------|-------------|--|
| 4            | (d) | <p><b>Rate</b><br/>(Acid) <b>concentration</b> decreases. ✓</p> <p><b>Collisions</b><br/>Fewer collisions per second<br/><b>OR</b> less frequent collisions ✓</p> | 2         | AO1.1<br>×2 | <p><b>IGNORE</b> amount of acid decreases, response must imply a volume and <b>NOT</b> area, e.g. fewer particles/molecules/ions in same space /volume</p> <p>'fewer collisions' alone is not sufficient (no rate)</p> |
|              | (e) | (i)   | 2         | AO1.2<br>×2 | <p><b>ALLOW</b> 'more' for 'greater proportion'</p> <p><b>ALLOW</b> more molecules have sufficient energy to react</p> <p><b>IGNORE</b> (more) successful collisions</p>   |
|              |     | (ii)  | 1         | AO2.1       | <p><b>ALLOW</b> idea that copper(II) sulfate solution is homogeneous in relation to the acid, but heterogeneous in relation to the zinc</p>  |
| <b>Total</b> |     |   | <b>13</b> |             |  |



| Question |     |       | Answer   | Marks | AO element  | Guidance   |
|----------|-----|-------|--|-------|-------------|--|
| 5        | (a) | (i)   | <p><b>Product with H<sub>2</sub></b></p> <pre>       H   H   H   H   H   H                             H — C — C — C — C — C — C — H                                   H   H   H   H   H   H     </pre> <p>✓</p> <p><b>Product with HCl</b></p> <pre>       H   H   H   H   H   H                             H — C — C — C — C — C — C — H                                   H   H   H   H   Cl  H     </pre> <p>✓</p> <p><b>Product with Br<sub>2</sub></b></p> <pre>       H   H   H   H   H   H                             H — C — C — C — C — C — C — H                                   H   H   H   H   Br  Br     </pre> <p>✓</p> | 3     | AO1.2<br>×3 | <p><b>ALLOW</b> any combination of skeletal <b>OR</b> structural <b>OR</b> displayed formula as long as unambiguous</p> <p><b>ALLOW</b> part molecular formulae but not full</p> |
|          |     | (ii)  | Nickel/Ni ✓  | 1     | AO1.2       | <b>ALLOW</b> Pt <b>OR</b> Pd <b>OR</b> Rh  |
|          |     | (iii) | (orange to) colourless<br><b>OR</b><br>bromine is decolourised ✓   | 1     | AO1.2       | <b>ALLOW</b> 'it decolourises / turns colourless'<br><b>IGNORE</b> colour change   |





| Question     |     |      | Answer  | Marks     | AO element  | Guidance  |
|--------------|-----|------|---|-----------|-------------|---|
| 5            | (b) | (ii) | Yield of hex-1-ene is less ✓<br><br>A mixture of hex-1-ene and hex-2-ene forms ✓  | 2         | AO3.2<br>×2 | <b>ALLOW</b> hex-2-ene also forms   |
|              | (c) | (i)  | $  \begin{array}{cccc}  \text{H} & \text{H} & \text{H} & \text{H} \\    &   &   &   \\  \text{---C---} & \text{C---} & \text{C---} & \text{C---} \\    &   &   &   \\  \text{C}_4\text{H}_9 & \text{H} & \text{C}_4\text{H}_9 & \text{H}  \end{array}  $ <p style="text-align: right;">✓</p> <p><b>NOTE:</b> C<sub>4</sub>H<sub>9</sub>– is allowed for CH<sub>3</sub>CH<sub>2</sub>CH<sub>2</sub>CH<sub>2</sub>–</p> | 1         | AO2.5       | <p><b>ALLOW</b> correct structural <b>OR</b> displayed <b>OR</b> skeletal formula</p> <p>Must show two repeat units</p> <p>Polymer must have side links</p> <p><b>IGNORE</b> brackets and use of 'n'</p> <p><b>ALLOW</b> alternating side chains, i.e.</p> $  \begin{array}{cccc}  \text{H} & \text{H} & \text{H} & \text{H} \\    &   &   &   \\  \text{---C---} & \text{C---} & \text{C---} & \text{C---} \\    &   &   &   \\  \text{C}_4\text{H}_9 & \text{H} & \text{H} & \text{C}_4\text{H}_9  \end{array}  $ |
|              |     | (ii) | Combustion for energy production ✓<br><br>for production of plastics<br><b>OR</b> other useful <b>organic</b> compounds ✓   | 2         | AO1.1<br>×2 | <p>For energy production,<br/><b>ALLOW</b> generate electricity/heating</p> <p><b>ALLOW</b> as an (organic) feedstock</p>   |
| <b>Total</b> |     |      |   | <b>16</b> |             |   |

**OCR (Oxford Cambridge and RSA Examinations)**  
**The Triangle Building**  
**Shaftesbury Road**  
**Cambridge**  
**CB2 8EA**

**OCR Customer Contact Centre**

**Education and Learning**

Telephone: 01223 553998

Facsimile: 01223 552627

Email: [general.qualifications@ocr.org.uk](mailto:general.qualifications@ocr.org.uk)

[www.ocr.org.uk](http://www.ocr.org.uk)

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Head office  
Telephone: 01223 552552  
Facsimile: 01223 552553

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