



**GCE**

**Chemistry A**

**H032/02:** Depth in chemistry

Advanced Subsidiary GCE

**Mark Scheme for June 2019**

OCR (Oxford Cambridge and RSA) is a leading UK awarding body, providing a wide range of qualifications to meet the needs of candidates of all ages and abilities. OCR qualifications include AS/A Levels, Diplomas, GCSEs, Cambridge Nationals, Cambridge Technicals, Functional Skills, Key Skills, Entry Level qualifications, NVQs and vocational qualifications in areas such as IT, business, languages, teaching/training, administration and secretarial skills.

It is also responsible for developing new specifications to meet national requirements and the needs of students and teachers. OCR is a not-for-profit organisation; any surplus made is invested back into the establishment to help towards the development of qualifications and support, which keep pace with the changing needs of today's society.















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 2019

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



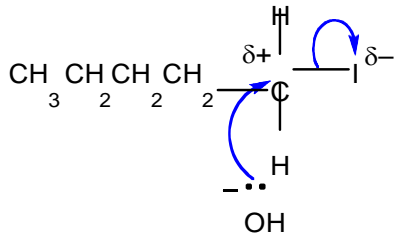
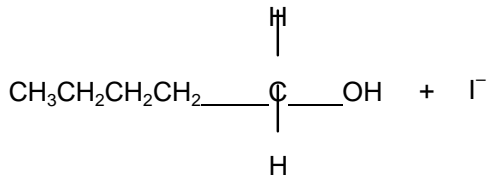
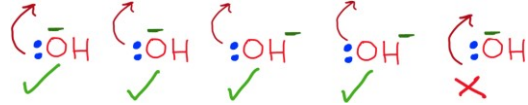
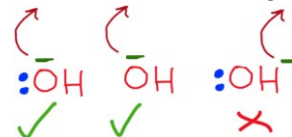

Question		Answer	Marks	AO element	Guidance
	(c) (ii)	Two points (✓✓) from With calcium: 1. less vigorous fizzing/bubbling/effervescence 2. dissolves more slowly/slower reaction 3. solution has a lower pH/less alkaline 4. precipitate forms/less soluble	2	AO2.3 ×2	<b>IGNORE</b> gives out less/more heat, less reactive, less gas
1	(d) (i)	<b>FIRST CHECK THE ANSWER ON ANSWER LINE</b> <b>If answer = 5.8 award 3 marks</b> ----- $n(\text{SrCl}_2) = \frac{1.04}{158.6} = 0.0102\dots\dots (\text{mol}) \checkmark$ $n(\text{H}_2\text{O}) = \frac{1.07}{18} = 0.0594\dots\dots (\text{mol}) \checkmark$ $x = \text{SrCl}_2 : \text{H}_2\text{O} = \frac{0.0594\dots\dots}{0.0102\dots\dots}$ $= 5.8 \checkmark$	3	AO3.1 ×2  AO3.2	<b>Calculator:</b> 0.01021437579  <b>Calculator:</b> 0.05944444444  <b>ALLOW ECF</b> from $n(\text{SrCl}_2)$ and/or $n(\text{H}_2\text{O})$  Answer must be to <b>TWO</b> significant figures  <b>ALLOW 2 marks</b> 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 ✓  Use a larger mass (of hydrated strontium chloride) ✓	2	AO3.4 ×2	<b>ALLOW</b> more precise/more accurate/ more sensitive/higher resolution/smaller division/ weigh to 0.001  <b>IGNORE</b> 'less error/smaller interval balance'  <b>IGNORE</b> any reference to lid on crucible (water can't escape)  <b>IGNORE</b> 'weigh straight after heating'  <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>  <b>If answer = 38.5 cm<sup>3</sup> award 3 marks</b></p> <p>-----</p> $n(\text{Mg}(\text{NO}_3)_2) = \frac{0.00}{148.3} = 0.0337 \dots\dots\dots (\text{mol}) \checkmark$ $n(\text{HNO}_3) = 2 \times 0.0337 \dots\dots\dots = 0.0674 \dots\dots\dots (\text{mol}) \checkmark$ $\text{volume} = 0.0674 \dots\dots\dots \times \frac{1000}{1.75} = 38.5 (\text{cm}^3) \checkmark$ <p style="text-align: right;"><b>3 SF required</b></p>	3	AO2.8 ×3	<p><b>Calculator:</b> 0.03371544167</p> <p><b>ALLOW ECF</b> from <math>n(\text{Mg}(\text{NO}_3)_2)</math>  <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  Change from: -2 to 0 ✓</p> <p>Element <b>reduced:</b> Nitrogen/N:  Change form + 5 to +4 ✓</p>	2	AO2.2 ×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, but oxidised and reduced the wrong way around</p> <p><b>IGNORE</b> numbers around equation  <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>  <b>AND</b>  curly arrow from C-I bond to I atom ✓</p>  <p><b>IGNORE</b> presence of Na<sup>+</sup> but OH<sup>-</sup> needed  i.e. Na<sup>+</sup>OH<sup>-</sup> can be allowed if the criteria are met</p> <hr/> <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  i.e. Na<sup>+</sup>I<sup>-</sup> can be allowed BUT NaI does not show I<sup>-</sup></p>	3	AO2.5 ×3	<p><b>ANNOTATE ANSWER WITH TICKS AND CROSSES</b>  <b>NOTE:</b> curly arrows can be straight, snake-like, etc.  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 on O of <sup>-</sup>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 <i>Question asks for measurement</i>

3	(a)	(iii)	C–I bond is weaker (than C–Br bond) <b>OR</b> C–I bond has a lower bond enthalpy (than C–Br bond) ✓  Carbon – halogen <b>bond breaks</b> ✓	2	AO3.2	<b>For 2 marks,</b> <b>ALLOW</b> C–I is broken more easily (than C–Br) as the bond is weaker  There must be a <b>comparison</b> between C–Br and C–I bonds
	(b)	(i)	Molecular mass ✓	1	AO1.1	<b>IGNORE</b> ‘relative’ <b>IGNORE</b> ‘molecular ion’ alone, answer must relate to <b>mass</b>  <b>ALLOW</b> $M_r$ / molar mass
		(ii)	Y: $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2^+$ ✓ Z: $\text{CH}_3\text{CH}_2\text{CH}_2^+$ ✓  <i>If positive charge is missing but the structures of Y AND Z are correct, award one mark</i>	2	AO3.2 x2	<b>FOR ONE MARK</b> <b>ALLOW</b> $\text{C}_5\text{H}_{11}^+$ <b>AND</b> $\text{C}_3\text{H}_7^+$  <b>ALLOW</b> any combination of skeletal <b>OR</b> structural <b>OR</b> displayed formula as long as unambiguous
	(c)	(i)	$  \begin{array}{ccccccc}  & \text{H} & & \text{CH}_3 & & \text{H} & & \text{H} \\  &   & &   & &   & &   \\  \text{H} & - \text{C} & - & \text{C} & - & \text{C} & - & \text{C} & - \text{H} \\  &   & &   & &   & &   \\  & \text{H} & & \text{I} & & \text{H} & & \text{H}  \end{array}  $ ✓	1	AO1.1	<b>ALLOW</b> any combination of skeletal <b>OR</b> structural <b>OR</b> displayed formula as long as unambiguous
		(ii)	<b>Similarity</b> Both have a peak at ( $m/z =$ ) 198 (X) <b>OR</b> 71 (Y) <b>OR</b> 29 ✓  <b>Difference</b> 2-iodo-2-methylbutane has <b>no</b> peak at ( $m/z =$ ) 43 (Z) ✓	2	AO3.2 x2	<b>ALLOW</b> same molecular ion peak / $M_r$  <b>IGNORE</b> statements where no specific ion peak is suggested e.g. “different ion peaks”
			<b>Total</b>	<b>12</b>		

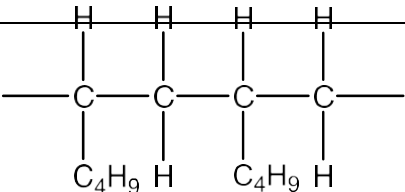
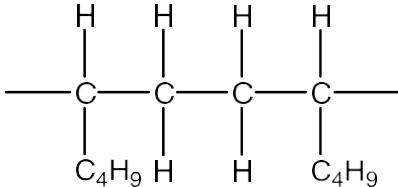
Question		Answer	Marks	AO element	Guidance
4	(a)	<p><b>FIRST CHECK THE ANSWER ON ANSWER LINE</b>  <b>If answer = 60 cm<sup>3</sup> award 3 marks</b></p> <p>-----</p> $n(\text{HCl}) = \frac{50.0}{1000} \times 0.100 = 5.00 \times 10^{-3} \text{ (mol) } \checkmark$ $n(\text{H}_2) = \frac{5.00 \times 10^{-3}}{2} = 2.50 \times 10^{-3} \text{ (mol) } \checkmark$ $\text{Volume} = 2.5(0) \times 10^{-3} \times 24.0 \times 1000 = 60(.0) \text{ cm}^3 \checkmark$	3	AO2.6 ×3	<p><b>ALLOW</b> 120 cm<sup>3</sup> for 2 marks (no ÷ 2)  <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>  <b>ALLOW ECF</b> from <math>n(\text{HCl})</math> and/or <math>n(\text{H}_2)</math></p>
	(b)	(i)	1	AO2.4 ×1	<p><b>ALLOW</b> Time (s) <b>OR</b> Time in s  <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  <b>ALLOW</b> up to 3 plotting errors</p>
		(ii)	1	AO2.4 ×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  <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 ×2	<p>Tolerance ± 1 small square</p>

Question		Answer	Marks	AO element	Guidance
4	(d)	<p><b>Rate</b> (Acid) <b>concentration</b> decreases. ✓</p> <p><b>Collisions</b> Fewer collisions per second <b>OR</b> less frequent collisions ✓</p>	2	AO1.1 ×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 ×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 ×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 <b>OR</b> bromine is decolourised ✓	1	AO1.2	<b>ALLOW</b> 'it decolourises / turns colourless' <b>IGNORE</b> colour change





Question			Answer	Marks	AO element	Guidance
5	(b)	(ii)	Yield of hex-1-ene is less ✓  A mixture of hex-1-ene and hex-2-ene forms ✓	2	AO3.2 ×2	<b>ALLOW</b> hex-2-ene also forms
	(c)	(i)	 <p style="text-align: center;">✓</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> 
		(ii)	Combustion for energy production ✓  for production of plastics <b>OR</b> other useful <b>organic</b> compounds ✓	2	AO1.1 ×2	For energy production, <b>ALLOW</b> generate electricity/heating  <b>ALLOW</b> as an (organic) feedstock
			<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)

For staff training purposes and as part of our quality assurance programme your call may be recorded or monitored

**Oxford Cambridge and RSA Examinations**  
is a Company Limited by Guarantee  
Registered in England  
Registered Office; The Triangle Building, Shaftesbury Road, Cambridge, CB2 8EA  
Registered Company Number: 3484466  
OCR is an exempt Charity

**OCR (Oxford Cambridge and RSA Examinations)**  
Head office  
Telephone: 01223 552552  
Facsimile: 01223 552553

© OCR 2019

