

# INTERNATIONAL GCSE **COMBINED SCIENCE**

## **9204/CE**

Paper 2 Chemistry Extension

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Mark scheme

November 2023

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Version: 1.0 Final



23BY9204/CE/MS

Mark schemes are prepared by the Lead Assessment Writer and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation events which all associates participate in and is the scheme which was used by them in this examination. The standardisation process ensures that the mark scheme covers the students' responses to questions and that every associate understands and applies it in the same correct way. As preparation for standardisation each associate analyses a number of students' scripts. Alternative answers not already covered by the mark scheme are discussed and legislated for. If, after the standardisation process, associates encounter unusual answers which have not been raised they are required to refer these to the Lead Examiner.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of students' reactions to a particular paper. Assumptions about future mark schemes on the basis of one year's document should be avoided; whilst the guiding principles of assessment remain constant, details will change, depending on the content of a particular examination paper.

Further copies of this mark scheme are available from [oxfordaqaexams.org.uk](https://www.oxfordaqaexams.org.uk)

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## Level of response marking instructions

Level of response mark schemes are broken down into levels, each of which has a descriptor. The descriptor for the level shows the average performance for the level. There are marks in each level.

Before you apply the mark scheme to a student's answer read through the answer and annotate it (as instructed) to show the qualities that are being looked for. You can then apply the mark scheme.

### Step 1 Determine a level

Start at the lowest level of the mark scheme and use it as a ladder to see whether the answer meets the descriptor for that level. The descriptor for the level indicates the different qualities that might be seen in the student's answer for that level. If it meets the lowest level then go to the next one and decide if it meets this level, and so on, until you have a match between the level descriptor and the answer. With practice and familiarity you will find that for better answers you will be able to quickly skip through the lower levels of the mark scheme.

When assigning a level you should look at the overall quality of the answer and not look to pick holes in small and specific parts of the answer where the student has not performed quite as well as the rest. If the answer covers different aspects of different levels of the mark scheme you should use a best fit approach for defining the level and then use the variability of the response to help decide the mark within the level, ie if the response is predominantly level 3 with a small amount of level 4 material it would be placed in level 3 but be awarded a mark near the top of the level because of the level 4 content.

### Step 2 Determine a mark

Once you have assigned a level you need to decide on the mark. The descriptors on how to allocate marks can help with this. The exemplar materials used during standardisation will help. There will be an answer in the standardising materials which will correspond with each level of the mark scheme. This answer will have been awarded a mark by the Lead Examiner. You can compare the student's answer with the example to determine if it is the same standard, better or worse than the example. You can then use this to allocate a mark for the answer based on the Lead Examiner's mark on the example.

You may well need to read back through the answer as you apply the mark scheme to clarify points and assure yourself that the level and the mark are appropriate.

Indicative content in the mark scheme is provided as a guide for examiners. It is not intended to be exhaustive and you must credit other valid points. Students do not have to cover all of the points mentioned in the Indicative content to reach the highest level of the mark scheme.

An answer which contains nothing of relevance to the question must be awarded no marks.

## Information to Examiners

### 1. General

The mark scheme for each question shows:

- the marks available for each part of the question
- the total marks available for the question
- the typical answer or answers which are expected
- extra information to help the Examiner make his or her judgement
- the Assessment Objectives, level of demand and specification content that each question is intended to cover.

The extra information is aligned to the appropriate answer in the left-hand part of the mark scheme and should only be applied to that item in the mark scheme.

At the beginning of a part of a question a reminder may be given, for example: where consequential marking needs to be considered in a calculation; or the answer may be on the diagram or at a different place on the script.

In general the right-hand side of the mark scheme is there to provide those extra details which confuse the main part of the mark scheme yet may be helpful in ensuring that marking is straightforward and consistent.

### 2. Emboldening and underlining

- 2.1** In a list of acceptable answers where more than one mark is available ‘any **two** from’ is used, with the number of marks emboldened. Each of the following bullet points is a potential mark.
- 2.2** A bold **and** is used to indicate that both parts of the answer are required to award the mark.
- 2.3** Alternative answers acceptable for a mark are indicated by the use of **or**. Different terms in the mark scheme are shown by a / ; eg allow smooth/free movement.
- 2.4** Any wording that is underlined is essential for the marking point to be awarded.

### 3. Marking points

#### 3.1 Marking of lists

This applies to questions requiring a set number of responses, but for which students have provided extra responses. The general principle to be followed in such a situation is that ‘right + wrong = wrong’.

Each error/contradiction negates each correct response. So, if the number of errors/contradictions equals or exceeds the number of marks available for the question, no marks can be awarded.

However, responses considered to be neutral (indicated as \* in example 1) are not penalised.

Example 1: What is the pH of an acidic solution?

[1 mark]

| Student | Response | Marks awarded |
|---------|----------|---------------|
| 1       | green, 5 | 0             |
| 2       | red*, 5  | 1             |
| 3       | red*, 8  | 0             |

Example 2: Name two planets in the solar system.

[2 marks]

| Student | Response                 | Marks awarded |
|---------|--------------------------|---------------|
| 1       | Neptune, Mars, Moon      | 1             |
| 2       | Neptune, Sun, Mars, Moon | 0             |

### 3.2 Use of chemical symbols/formulae

If a student writes a chemical symbol/formula instead of a required chemical name, full credit can be given if the symbol/formula is correct and if, in the context of the question, such action is appropriate.

### 3.3 Marking procedure for calculations

Marks should be awarded for each stage of the calculation completed correctly, as students are instructed to show their working. Full marks can, however, be given for a correct numerical answer, without any working shown.

### 3.4 Interpretation of 'it'

Answers using the word 'it' should be given credit only if it is clear that the 'it' refers to the correct subject.

### 3.5 Errors carried forward

Any error in the answers to a structured question should be penalised once only.

Papers should be constructed in such a way that the number of times errors can be carried forward is kept to a minimum. Allowances for errors carried forward are most likely to be restricted to calculation questions and should be shown by the abbreviation ecf in the marking scheme.

### 3.6 Phonetic spelling

The phonetic spelling of correct scientific terminology should be credited **unless** there is a possible confusion with another technical term.

### 3.7 Brackets

(.....) are used to indicate information which is not essential for the mark to be awarded but is included to help the examiner identify the sense of the answer required.

**3.8 Allow**

In the mark scheme additional information, 'allow' is used to indicate creditworthy alternative answers.

**3.9 Ignore**

Ignore is used when the information given is irrelevant to the question or not enough to gain the marking point. Any further correct amplification could gain the marking point.

**3.10 Do not accept**

Do **not** accept means that this is a wrong answer which, even if the correct answer is given as well, will still mean that the mark is not awarded.

| Question | Answers       | Extra information | Mark | AO/Spec. Ref.  |
|----------|---------------|-------------------|------|----------------|
| 01.1     | crimson / red |                   | 1    | AO1<br>3.10.2a |

| Question | Answers                                   | Extra information                                                                                                                                                                             | Mark | AO/Spec. Ref. |
|----------|-------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|---------------|
| 01.2     | lithium (atom) loses electron(s)          |                                                                                                                                                                                               | 1    | AO2<br>3.8.1c |
|          | chlorine (atom) gains electron(s)         |                                                                                                                                                                                               | 1    |               |
|          | one electron is transferred               |                                                                                                                                                                                               | 1    |               |
|          | lithium ions and chloride ions are formed | allow $\text{Li}^+$ ions and $\text{Cl}^-$ ions are formed<br><br>allow lithium forms positive ions and chlorine forms negative ions<br><br>allow to form a complete outer shell of electrons | 1    |               |

| Question | Answers | Extra information | Mark | AO/Spec. Ref.  |
|----------|---------|-------------------|------|----------------|
| 01.3     | white   |                   | 1    | AO1<br>3.10.2f |

| Question | Answers                                                 | Extra information                                                                                                    | Mark | AO/Spec. Ref.  |
|----------|---------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------|------|----------------|
| 01.4     | (percentage Li) = $\frac{(2 \times 7)}{110} \times 100$ | $\left\{ \begin{array}{l} \text{allow 1 mark for} \\ \frac{7}{110} \times 100 = 6.363636 \end{array} \right.$        | 1    | AO2<br>3.12.2b |
|          | = 12.72727                                              |                                                                                                                      | 1    |                |
|          | = 12.7 (%)                                              |                                                                                                                      | 1    |                |
|          |                                                         | allow an answer correctly rounded to 3 significant figures from a calculation which uses the values in the question. |      |                |

|       |  |  |   |  |
|-------|--|--|---|--|
| Total |  |  | 9 |  |
|-------|--|--|---|--|

| Question | Answers        | Extra information     | Mark | AO/Spec. Ref.   |
|----------|----------------|-----------------------|------|-----------------|
| 02.1     | carbon dioxide | allow CO <sub>2</sub> | 1    | AO1<br>3.9.1.2b |

| Question | Answers                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Mark | AO/Spec. Ref.  |
|----------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|----------------|
| 02.2     | <b>Level 3:</b> The method would lead to the production of a valid outcome. The key steps are identified and logically sequenced.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 5–6  | AO4<br>3.14.1f |
|          | <b>Level 2:</b> The method would not necessarily lead to a valid outcome. Most steps are identified, but the plan is not fully logically sequenced.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 3–4  |                |
|          | <b>Level 1:</b> The method would not lead to a valid outcome. Some relevant steps are identified, but links are not made clear.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | 1–2  |                |
|          | No relevant content                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 0    |                |
|          | <b>Indicative content</b> <ul style="list-style-type: none"> <li>• measure mass of calcium carbonate pieces</li> <li>• measure fixed volume of (hydrochloric) acid</li> <li>• measure volume with a measuring cylinder</li> <li>• add (hydrochloric) acid to conical flask</li> <li>• add calcium carbonate pieces to (hydrochloric) acid</li> <li>• measure time taken to achieve set decrease in mass</li> <li><b>or</b></li> <li>• measure mass of container in a set time</li> <li>• repeat with different sized calcium carbonate pieces</li> <li>• same mass of calcium carbonate pieces</li> <li>• same concentration of (hydrochloric) acid</li> <li>• same volume of (hydrochloric) acid</li> </ul> |      |                |

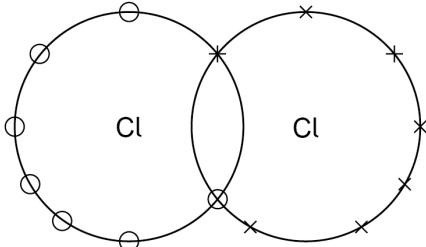
| Question | Answers                                                                                                       | Extra information | Mark   | AO/Spec. Ref.  |
|----------|---------------------------------------------------------------------------------------------------------------|-------------------|--------|----------------|
| 02.3     | increases the rate of reaction<br>(because increasing the surface area) increases the frequency of collisions |                   | 1<br>1 | AO1<br>3.14.1f |

| Question    | Answers                                                                                  | Extra information | Mark       | AO/Spec.<br>Ref.   |
|-------------|------------------------------------------------------------------------------------------|-------------------|------------|--------------------|
| <b>02.4</b> | curve <b>Y</b> is steeper at the start<br><br>(which) shows a faster rate of<br>reaction |                   | 1<br><br>1 | AO3<br><br>3.14.1c |

|              |  |  |           |
|--------------|--|--|-----------|
| <b>Total</b> |  |  | <b>11</b> |
|--------------|--|--|-----------|

| Question | Answers      | Extra information | Mark | AO/Spec. Ref.  |
|----------|--------------|-------------------|------|----------------|
| 03.1     | fluorine / F |                   | 1    | AO1<br>3.13.1d |

| Question | Answers              | Extra information | Mark | AO/Spec. Ref. |
|----------|----------------------|-------------------|------|---------------|
| 03.2     | (from) gas to liquid |                   | 1    | AO3<br>3.7.1a |

| Question | Answers                                                                         | Extra information                                                                                                                                                                                          | Mark   | AO/Spec. Ref. |
|----------|---------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|---------------|
| 03.3     | 1 pair of electrons in overlap<br>6 non-bonding electrons on each chlorine atom | allow any combination of<br>•, o, x or e <sup>(-)</sup> for electrons<br><br>an answer of<br><br>scores <b>2</b> marks | 1<br>1 | AO1<br>3.8.1g |

| Question | Answers | Extra information | Mark | AO/Spec. Ref.  |
|----------|---------|-------------------|------|----------------|
| 03.4     | -1      |                   | 1    | AO1<br>3.13.1c |

| Question | Answers                                                                                                                     | Extra information                   | Mark | AO/Spec. Ref.  |
|----------|-----------------------------------------------------------------------------------------------------------------------------|-------------------------------------|------|----------------|
| 03.5     | <p><b>Solution</b></p> <p><b>Name of solution</b></p> <p>do <b>not</b> accept more than one line from a box on the left</p> | allow 1 mark for one or two correct | 2    | AO3<br>3.13.1e |

| Question | Answers                                                                                                                                                                                                                              | Extra information                                                                                                                                                                                                                                                                                 | Mark                       | AO/Spec. Ref.  |
|----------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------|----------------|
| 03.6     | <p>(fluorine's) outer energy level is closer to the nucleus</p> <p>(so) there is more (electrostatic) attraction between the nucleus and the outer energy level (in fluorine)</p> <p>(so fluorine) gains an electron more easily</p> | <p>allow shell for energy level throughout</p> <p>allow converse argument in terms of chlorine</p> <p>allow the (fluorine) atom is smaller</p> <p>allow (fluorine) has fewer energy levels</p> <p>allow (so) there is less shielding between the outer electron and the nucleus (in fluorine)</p> | <p>1</p> <p>1</p> <p>1</p> | AO1<br>3.13.1f |

|              |  |  |           |
|--------------|--|--|-----------|
| <b>Total</b> |  |  | <b>10</b> |
|--------------|--|--|-----------|

| Question    | Answers                                                                                             | Extra information | Mark | AO/Spec. Ref.                     |
|-------------|-----------------------------------------------------------------------------------------------------|-------------------|------|-----------------------------------|
| <b>04.1</b> | germanium and zinc are different elements because they have different number of protons             |                   | 1    | AO2<br>3.7.2f<br>3.7.2g<br>3.7.2h |
|             | (however) the mass numbers are the same because they have same total number of protons and neutrons |                   | 1    |                                   |

| Question    | Answers                                                          | Extra information                                                                           | Mark | AO/Spec. Ref. |
|-------------|------------------------------------------------------------------|---------------------------------------------------------------------------------------------|------|---------------|
| <b>04.2</b> | germanium and zinc are in different groups of the periodic table | allow germanium and zinc have a different number of electrons in their highest energy level | 1    | AO2<br>3.7.3b |

| Question    | Answers                                                 | Extra information                                              | Mark | AO/Spec. Ref.   |
|-------------|---------------------------------------------------------|----------------------------------------------------------------|------|-----------------|
| <b>04.3</b> | lead oxide + carbon $\rightarrow$ lead + carbon dioxide | allow lead oxide + carbon $\rightarrow$ lead + carbon monoxide | 1    | AO2<br>3.9.1.1d |

| Question    | Answers                                                   | Extra information | Mark | AO/Spec. Ref. |
|-------------|-----------------------------------------------------------|-------------------|------|---------------|
| <b>04.4</b> | zinc forms as a gas (and separates from the lead)         |                   | 1    | AO3<br>3.7.1a |
|             | (then) the zinc can be condensed (to a liquid) by cooling |                   | 1    |               |

| Question    | Answers                                  | Extra information | Mark | AO/Spec. Ref.   |
|-------------|------------------------------------------|-------------------|------|-----------------|
| <b>04.5</b> | aluminium is more reactive (than carbon) |                   | 1    | AO1<br>3.9.1.1e |

| Question | Answers                         | Extra information                                                                                                        | Mark | AO/Spec. Ref. |
|----------|---------------------------------|--------------------------------------------------------------------------------------------------------------------------|------|---------------|
| 04.6     | aluminium ions gain 3 electrons | allow <b>1</b> mark for aluminium ions gain electrons<br><b>or</b><br>allow <b>1</b> mark for aluminium ions are reduced | 2    | AO2<br>3.9.2e |

| Question | Answers                                                                                    | Extra information | Mark        | AO/Spec. Ref. |
|----------|--------------------------------------------------------------------------------------------|-------------------|-------------|---------------|
| 04.7     | the electrode is made of carbon<br>(which) reacts with oxygen<br>to produce carbon dioxide |                   | 1<br>1<br>1 | AO1<br>3.9.2i |

|              |  |  |           |
|--------------|--|--|-----------|
| <b>Total</b> |  |  | <b>12</b> |
|--------------|--|--|-----------|

| Question    | Answers                                                    | Extra information | Mark | AO/Spec. Ref.    |
|-------------|------------------------------------------------------------|-------------------|------|------------------|
| <b>05.1</b> | (molecules which) contain only carbon and hydrogen (atoms) |                   | 1    | AO1<br>3.16.1.1b |

| Question    | Answers                                               | Extra information | Mark | AO/Spec. Ref.    |
|-------------|-------------------------------------------------------|-------------------|------|------------------|
| <b>05.2</b> | all (carbon-carbon) bonds are single (covalent) bonds |                   | 1    | AO1<br>3.16.1.2a |

| Question    | Answers                | Extra information                                           | Mark | AO/Spec. Ref.    |
|-------------|------------------------|-------------------------------------------------------------|------|------------------|
| <b>05.3</b> | alkane may set on fire | allow difficult to control temperature with a Bunsen burner | 1    | AO4<br>3.16.1.2c |

| Question    | Answers                                              | Extra information                                                              | Mark | AO/Spec. Ref.    |
|-------------|------------------------------------------------------|--------------------------------------------------------------------------------|------|------------------|
| <b>05.4</b> | as the temperature increases the viscosity decreases | allow 1 mark for as the temperature increases the time taken to flow decreases | 2    | AO3<br>3.16.1.2c |
|             | change gets smaller as temperature gets higher       |                                                                                | 1    |                  |

| Question    | Answers                                                                                                                                                                                                                                                                                                   | Extra information                                                | Mark | AO/Spec. Ref.  |
|-------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------|------|----------------|
| <b>05.5</b> | (mass of hydrogen = $13.8 - 7.2 - 4.8 = 1.8$ )                                                                                                                                                                                                                                                            |                                                                  | 1    | AO2<br>3.12.2c |
|             | (moles =)<br><div style="display: flex; justify-content: space-around;"> <div style="text-align: center;">C<br/><math>\frac{7.2}{12}</math></div> <div style="text-align: center;">O<br/><math>\frac{4.8}{16}</math></div> <div style="text-align: center;">H<br/><math>\frac{1.8}{1}</math></div> </div> | allow correct use of an incorrectly determined mass of hydrogen  | 1    |                |
|             | = 0.6      = 0.3      = 1.8                                                                                                                                                                                                                                                                               |                                                                  | 1    |                |
|             | (ratio=)<br><div style="display: flex; justify-content: space-around;"> <div style="text-align: center;"><math>\frac{0.6}{0.3} = 2</math></div> <div style="text-align: center;"><math>\frac{0.3}{0.3} = 1</math></div> <div style="text-align: center;"><math>\frac{1.8}{0.3} = 6</math></div> </div>    | allow correct use of incorrectly determined value(s) for mole(s) | 1    |                |
|             | C <sub>2</sub> H <sub>6</sub> O                                                                                                                                                                                                                                                                           | allow correct use of an incorrectly determined ratio             | 1    |                |

| Question    | Answers                                                                            | Extra information                                               | Mark | AO/Spec. Ref.    |
|-------------|------------------------------------------------------------------------------------|-----------------------------------------------------------------|------|------------------|
| <b>05.6</b> | $2\text{H}_2\text{S} + 3\text{O}_2 \rightarrow 2\text{SO}_2 + 2\text{H}_2\text{O}$ | allow 1 mark for H <sub>2</sub> O with incorrect / no balancing | 2    | AO2<br>3.16.1.2d |

| Question    | Answers   | Extra information | Mark | AO/Spec. Ref.    |
|-------------|-----------|-------------------|------|------------------|
| <b>05.7</b> | acid rain |                   | 1    | AO1<br>3.16.1.2d |

| Question    | Answers                                               | Extra information                                        | Mark | AO/Spec. Ref.    |
|-------------|-------------------------------------------------------|----------------------------------------------------------|------|------------------|
| <b>05.8</b> | incomplete combustion (of hydrocarbon)                |                                                          | 1    | AO1<br>3.16.1.2d |
|             | (which) produces carbon / soot                        | allow (and) releases unburnt fuel                        | 1    |                  |
|             | (which) are solid particles (that block out sunlight) | allow (which) are particulates (that block out sunlight) | 1    |                  |

| Question    | Answers                                                                                 | Extra information | Mark       | AO/Spec. Ref.    |
|-------------|-----------------------------------------------------------------------------------------|-------------------|------------|------------------|
| <b>05.9</b> | nitrogen (from the air) reacts with oxygen<br>at a high temperature (in the car engine) |                   | 1<br><br>1 | AO1<br>3.16.1.2d |

|              |  |  |           |
|--------------|--|--|-----------|
| <b>Total</b> |  |  | <b>19</b> |
|--------------|--|--|-----------|

| Question | Answers                                                 | Extra information                                  | Mark | AO/Spec. Ref.               |
|----------|---------------------------------------------------------|----------------------------------------------------|------|-----------------------------|
| 06.1     | $C_{14}H_{30} \rightarrow 2C_2H_4 + C_3H_6 + C_7H_{16}$ | allow 1 mark for $C_7H_{16}$ if equation incorrect | 2    | AO2<br>3.12.1a<br>3.16.1.3a |

| Question | Answers                                                                                                                    | Extra information | Mark       | AO/Spec. Ref.    |
|----------|----------------------------------------------------------------------------------------------------------------------------|-------------------|------------|------------------|
| 06.2     | heat (to vaporise hydrocarbons)<br><br>(vapours are passed over) a catalyst<br><b>or</b><br>(vapours are) mixed with steam |                   | 1<br><br>1 | AO1<br>3.16.1.3a |

| Question | Answers                                                                                                                                                                                                                                                                                                      | Extra information | Mark | AO/Spec. Ref.                 |
|----------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|------|-------------------------------|
| 06.3     | any <b>two</b> from:<br><ul style="list-style-type: none"> <li>• (hydrocarbons present after cracking) have a lower boiling point</li> <li>• (hydrocarbons present after cracking) have a higher flammability</li> <li>• (some hydrocarbons present after cracking) will react with bromine water</li> </ul> |                   | 2    | AO3<br>3.16.1.2c<br>3.16.1.3d |

| Question | Answers                                                                                                                                                                                                                                                                            | Extra information                                                                                                                                                                                                                                   | Mark | AO/Spec. Ref.  |
|----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|----------------|
| 06.4     | $n \begin{array}{c} \text{H} & \text{H} \\   &   \\ \text{C} = & \text{C} \\   &   \\ \text{H} & \text{CH}_3 \end{array} \longrightarrow \left[ \begin{array}{c} \text{H} & \text{H} \\   &   \\ -\text{C} - & \text{C}- \\   &   \\ \text{H} & \text{CH}_3 \end{array} \right]_n$ | <p>allow for <b>1</b> mark <math>-\text{C}-\text{C}-</math></p> <p>allow for <b>1</b> mark <math>1 \times \text{C}-\text{CH}_3</math> and <math>3 \times \text{C}-\text{H}</math></p> <p>allow for <b>1</b> mark <math>n</math> outside bracket</p> | 3    | AO2<br>3.16.2a |

|              |  |  |          |
|--------------|--|--|----------|
| <b>Total</b> |  |  | <b>9</b> |
|--------------|--|--|----------|

| Question | Answers       | Extra information   | Mark | AO/Spec. Ref.   |
|----------|---------------|---------------------|------|-----------------|
| 07.1     | use a pipette | allow use a burette | 1    | AO4<br>3.12.4 b |

| Question | Answers                                    | Extra information | Mark | AO/Spec. Ref.   |
|----------|--------------------------------------------|-------------------|------|-----------------|
| 07.2     | add (sulfuric acid) dropwise near endpoint |                   | 1    | AO4<br>3.12.4 b |

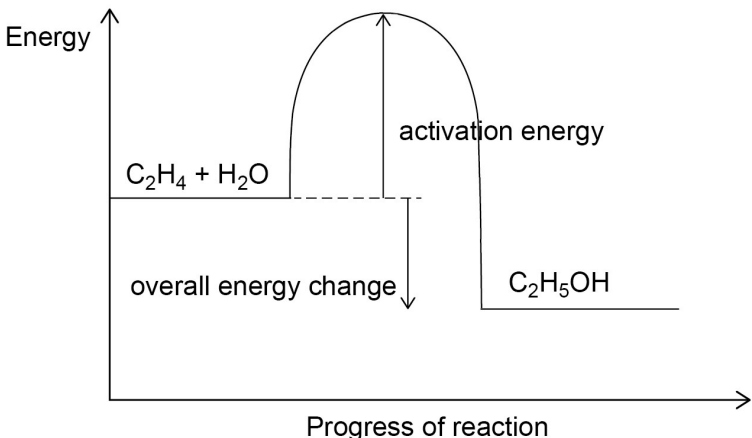
| Question | Answers                            | Extra information                                                                                                               | Mark | AO/Spec. Ref.               |
|----------|------------------------------------|---------------------------------------------------------------------------------------------------------------------------------|------|-----------------------------|
| 07.3     | repeat <b>and</b> calculate a mean | allow repeat experiment until results within 0.1 cm <sup>3</sup><br><br>allow repeat experiment until gained concordant results | 1    | AO4<br>3.12.4 b<br>3.12.4 c |

| Question | Answers                                                   | Extra information    | Mark | AO/Spec. Ref.  |
|----------|-----------------------------------------------------------|----------------------|------|----------------|
| 07.4     | $\text{H}^+ + \text{OH}^- \rightarrow \text{H}_2\text{O}$ | ignore state symbols | 1    | AO1<br>3.11.1g |

| Question    | Answers                                                                                   | Extra information                                                                                | Mark | AO/Spec. Ref.               |
|-------------|-------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------|------|-----------------------------|
| <b>07.5</b> | $\left( \text{moles KOH} = 0.220 \times \frac{25}{1000} \right)$ $= 0.0055 \text{ (mol)}$ |                                                                                                  | 1    | AO2<br>3.12.4 a<br>3.12.4 c |
|             | $\left( \text{moles H}_2\text{SO}_4 = \frac{0.0055}{2} \right)$ $= 0.00275 \text{ (mol)}$ | allow correct use of an incorrectly determined value for moles of KOH                            | 1    |                             |
|             | $(\text{conc H}_2\text{SO}_4 =) 0.00275 \times \frac{1000}{20}$                           | allow correct use of an incorrectly determined value for moles of H <sub>2</sub> SO <sub>4</sub> | 1    |                             |
|             | $= 0.1375 \text{ (mol/dm}^3\text{)}$                                                      |                                                                                                  | 1    |                             |

|              |  |  |          |
|--------------|--|--|----------|
| <b>Total</b> |  |  | <b>8</b> |
|--------------|--|--|----------|

| Question    | Answers                                                                       | Extra information                                                                    | Mark | AO/Spec. Ref. |
|-------------|-------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|------|---------------|
| <b>08.1</b> | (for bonds broken)<br>$(612 + (2 \times 464) + (4 \times 413) =)$<br>3192     |                                                                                      | 1    | AO2           |
|             | (for bonds made)<br>$(347 + 335 + 464 + (5 \times 413) =)$<br>3234            |                                                                                      | 1    | 3.15.2b       |
|             | (overall energy change =<br>$3192 - 3234 =$ ) (-)42 (kJ/mol)                  | allow correct use of incorrectly<br>determined values from step 1<br>and / or step 2 | 1    | 3.15.2c       |
|             | <b>alternative approach:</b><br>(for bonds broken)<br>$(612 + 464 =)$ 1076(1) |                                                                                      |      |               |
|             | (for bonds made) $(347 + 358 +$<br>$413 =)$ 1118 (1)                          |                                                                                      |      |               |
|             | (overall energy change =<br>$1076 - 1118 =$ ) (-)42 (kJ/mol)<br>(1)           | allow correct use of incorrectly<br>determined values from step 1<br>and / or step 2 |      |               |

| Question    | Answers                                                                                             | Extra information                                                                | Mark | AO/Spec. Ref. |
|-------------|-----------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------|------|---------------|
| <b>08.2</b> | product level below reactants with $C_2H_5OH$ on line                                               |                                                                                  | 1    | AO1 × 2       |
|             | correct shape of energy profile                                                                     | if product level above reactants allow correct shape for an endothermic reaction | 1    | AO2 × 2       |
|             | activation energy drawn and labelled                                                                |                                                                                  | 1    | 3.15.2a       |
|             | overall energy change drawn and labelled                                                            |                                                                                  | 1    |               |
|             | an answer of<br> |                                                                                  |      |               |
|             | scores <b>4</b> marks                                                                               |                                                                                  |      |               |

| Question    | Answers                                                       | Extra information | Mark | AO/Spec. Ref. |
|-------------|---------------------------------------------------------------|-------------------|------|---------------|
| <b>08.3</b> | compound <b>X</b> and ethanol both burn in air                |                   | 1    | AO3           |
|             | compound <b>X</b> and ethanol both dissolve in water          |                   | 1    | 3.16.3.1b     |
|             | compound <b>X</b> does not react with sodium but ethanol does |                   | 1    |               |

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| Question | Answers       | Extra information | Mark | AO/Spec.<br>Ref. |
|----------|---------------|-------------------|------|------------------|
| 8.4      | ethanoic acid |                   | 1    | AO1<br>3.16.3.1c |

|              |  |  |           |
|--------------|--|--|-----------|
| <b>Total</b> |  |  | <b>11</b> |
|--------------|--|--|-----------|

| Question | Answers           | Extra information | Mark | AO/Spec. Ref.  |
|----------|-------------------|-------------------|------|----------------|
| 09.1     | white precipitate |                   | 1    | AO1<br>3.10.2e |

| Question | Answers                                                                                                               | Extra information                            | Mark | AO/Spec. Ref.              |
|----------|-----------------------------------------------------------------------------------------------------------------------|----------------------------------------------|------|----------------------------|
| 09.2     | compound <b>XCl</b> has a giant ionic lattice                                                                         | allow <b>XCl</b> has a regular structure     | 1    | AO3                        |
|          | with electrostatic forces of attraction between oppositely charged ions                                               |                                              | 1    | AO2<br>3.8.1c<br>3.8.1f    |
|          | compound <b>ZCl</b> consists of simple molecules                                                                      | allow <b>ZCl</b> consists of small molecules | 1    | 3.8.1h<br>3.8.2a<br>3.8.2c |
|          | with (weak) intermolecular forces between molecules                                                                   | allow <b>ZCl</b> is molecular                | 1    | 3.8.2d                     |
|          | (so) more energy is required to break (electrostatic) forces in <b>XCl</b> than (intermolecular) forces in <b>ZCl</b> |                                              | 1    |                            |

| Question     | Answers                                       | Extra information                                                    | Mark      | AO/Spec. Ref.  |
|--------------|-----------------------------------------------|----------------------------------------------------------------------|-----------|----------------|
| <b>09.3</b>  | (moles of AgCl = $\frac{14.35}{143.5}$ =) 0.1 |                                                                      | 1         | AO2<br>3.12.1d |
|              | (moles of QCl =) 0.1                          | allow correct use of incorrectly determined value of moles           | 1         | 3.12.3a        |
|              | ( $M_r$ of QCl = $\frac{5.85}{0.1}$ =) 58.5   | allow correct use of incorrectly determined value of AgCl and/or QCl | 1         |                |
|              | ( $A_r$ Q = 58.5 – 35.5) = 23                 | allow correct use of incorrectly determined value of $M_r$ of QCl    | 1         |                |
|              | sodium                                        | allow Na<br>allow correct use of incorrect $A_r$ of Q                | 1         |                |
| <b>Total</b> |                                               |                                                                      | <b>11</b> |                |