



Pearson

# Mark Scheme (Results)

## November 2021

Pearson Edexcel GCSE  
In Chemistry (1CH0) Paper 2F

## **Edexcel and BTEC Qualifications**

Edexcel and BTEC qualifications are awarded by Pearson, the UK's largest awarding body. We provide a wide range of qualifications including academic, vocational, occupational and specific programmes for employers. For further information visit our qualifications websites at [www.edexcel.com](http://www.edexcel.com) or [www.btec.co.uk](http://www.btec.co.uk). Alternatively, you can get in touch with us using the details on our contact us page at [www.edexcel.com/contactus](http://www.edexcel.com/contactus).

## **Pearson: helping people progress, everywhere**

Pearson aspires to be the world's leading learning company. Our aim is to help everyone progress in their lives through education. We believe in every kind of learning, for all kinds of people, wherever they are in the world. We've been involved in education for over 150 years, and by working across 70 countries, in 100 languages, we have built an international reputation for our commitment to high standards and raising achievement through innovation in education. Find out more about how we can help you and your students at: [www.pearson.com/uk](http://www.pearson.com/uk)

November 2021

Publications Code 1CH0\_2F\_2111\_MS

All the material in this publication is copyright

© Pearson Education Ltd 2021

## General Marking Guidance

- All candidates must receive the same treatment. Examiners must mark the first candidate in exactly the same way as they mark the last.
- Mark schemes should be applied positively. Candidates must be rewarded for what they have shown they can do rather than penalised for omissions.
- Examiners should mark according to the mark scheme not according to their perception of where the grade boundaries may lie.
- There is no ceiling on achievement. All marks on the mark scheme should be used appropriately.
- All the marks on the mark scheme are designed to be awarded. Examiners should always award full marks if deserved, i.e. if the answer matches the mark scheme. Examiners should also be prepared to award zero marks if the candidate's response is not worthy of credit according to the mark scheme.
- Where some judgement is required, mark schemes will provide the principles by which marks will be awarded and exemplification may be limited.
- When examiners are in doubt regarding the application of the mark scheme to a candidate's response, the team leader must be consulted.
- Crossed out work should be marked UNLESS the candidate has replaced it with an alternative response
- Mark schemes have been developed so that the rubrics of each mark scheme reflects the characteristics of the skills within the AO being targeted and the requirements of the command word. So for example the command word 'Explain' requires an identification of a point and then reasoning/justification of the point.

Explain questions can be asked across all AOs. The distinction comes whether the identification is via a judgment made to reach a conclusion, or, making a point through application of knowledge to reason/justify the point made through application of understanding. It is the combination and linkage of the marking points that is needed to gain full marks.

When marking questions with a 'describe' or 'explain' command word, the detailed marking guidance below should be consulted to ensure consistency of marking.

| Assessment Objective |           | Command Word                                                                                                                    |                                                                                                                                         |
|----------------------|-----------|---------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------|
| Strand               | Element   | Describe                                                                                                                        | Explain                                                                                                                                 |
| AO1*                 |           | An answer that combines the marking points to provide a logical description                                                     | An explanation that links identification of a point with reasoning/justification(s) as required                                         |
| AO2                  |           | An answer that combines the marking points to provide a logical description, showing application of knowledge and understanding | An explanation that links identification of a point (by applying knowledge) with reasoning/justification (application of understanding) |
| AO3                  | 1a and 1b | An answer that combines points of interpretation/evaluation to provide a logical description                                    |                                                                                                                                         |
| AO3                  | 2a and 2b |                                                                                                                                 | An explanation that combines identification via a judgment to reach a conclusion via justification/reasoning                            |
| AO3                  | 3a        | An answer that combines the marking points to provide a logical description of the plan/method/experiment                       |                                                                                                                                         |
| AO3                  | 3b        |                                                                                                                                 | An explanation that combines identifying an improvement of the experimental procedure with a linked justification/reasoning             |

\*there will be situations where an AO1 question will include elements of recall of knowledge directly from the specification (up to a maximum of 15%). These will be identified by an asterisk in the mark scheme.

**Paper 2F Foundation Tier**

| Question number | Answer                                                                                 | Mark                  |
|-----------------|----------------------------------------------------------------------------------------|-----------------------|
| 1(a)            | <b>D</b> does not dissolve in water<br><br><b>A, B and C</b> are not factually correct | (1)<br><br><b>AO2</b> |

| Question number | Answer  | Mark                  |
|-----------------|---------|-----------------------|
| 1(b)(i)         | polymer | (1)<br><br><b>AO3</b> |

| Question number | Answer                                                                                                                                                                                                                                                                                     | Mark                  |
|-----------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|
| 1(b)(ii)        | <b>B</b> electrons<br><br><b>A</b> is not correct because atoms do not move through the metallic structure.<br><b>C</b> is not correct because neutrons do not move through the metallic structure.<br><b>D</b> is not correct because protons do not move through the metallic structure. | (1)<br><br><b>AO1</b> |

| Question number | Answer                                                                           | Mark                  |
|-----------------|----------------------------------------------------------------------------------|-----------------------|
| 1(c)(i)         | breathed in / absorbed by the skin / consumed within food and drink / medication | (1)<br><br><b>AO2</b> |

| Question number | Answer                                                     | Mark                  |
|-----------------|------------------------------------------------------------|-----------------------|
| 1(c)(ii)        | catalyse (harmful) reactions / build up and form blockages | (1)<br><br><b>AO1</b> |

|           | Answer | Mark                  |
|-----------|--------|-----------------------|
| 1(c)(iii) | 1.2 :1 | (1)<br><br><b>AO2</b> |

| Question number | Answer                                                                                                                                                 | Mark           |
|-----------------|--------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|
| 2(a)            | any two from:<br><br>concentration of acid (1)<br><br>{size / shape / surface area / length} area of magnesium ribbon (1)<br><br>mass of magnesium (1) | (2)<br><br>AO2 |

| Question number | Answer                                                        | Mark           |
|-----------------|---------------------------------------------------------------|----------------|
| 2(b)            | B measuring cylinder<br><br>A, C and D do not measure volumes | (1)<br><br>AO2 |

| Question number | Answer                               | Mark           |
|-----------------|--------------------------------------|----------------|
| 2(c)            | magnesium has gone / no more bubbles | (1)<br><br>AO2 |

| Question number | Answer                                                                                          | Additional guidance         | Mark           |
|-----------------|-------------------------------------------------------------------------------------------------|-----------------------------|----------------|
| 2(d)            | (particles) have more energy / (particles) collide more frequently / more successful collisions | allow particles move faster | (1)<br><br>AO1 |

| Question number | Answer                                                                    | Additional guidance     | Mark           |
|-----------------|---------------------------------------------------------------------------|-------------------------|----------------|
| 2(e)            | $\frac{15.0}{60.0}$ (1)<br><br>= 0.25 (1) ( $\text{cm}^3 \text{s}^{-1}$ ) | $\frac{60}{15} = 4$ (1) | (2)<br><br>AO2 |

| Question number | Answer                          | Mark           |
|-----------------|---------------------------------|----------------|
| 3(a)(i)         | (outer shell is) full/ complete | (1)<br><br>AO1 |

| Question number | Answer                                                                                                                                                                                                       | Additional guidance              | Mark           |
|-----------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------|----------------|
| 3(a)(ii)        | An explanation linking <ul style="list-style-type: none"><li>hydrogen is flammable / could ignite (1)</li><li>krypton is more dense than air (1)</li><li>(so krypton) air ship would not float (1)</li></ul> | allow krypton has a high density | (3)<br><br>AO3 |

| Question number | Answer                                                       | Mark           |
|-----------------|--------------------------------------------------------------|----------------|
| 3(b)            | had yet to be discovered / unknown / did not know about them | (1)<br><br>AO1 |

| Question number | Answer                                            | Additional guidance                                                  | Mark           |
|-----------------|---------------------------------------------------|----------------------------------------------------------------------|----------------|
| 3(c)(i)         | neon bar correct (1)<br><br>argon bar correct (1) | if no other mark scored, allow 1 for neon -252 <b>and</b> argon -192 | (2)<br><br>AO2 |

| Question number | Answer                           | Mark           |
|-----------------|----------------------------------|----------------|
| 3(c)(ii)        | allow any value from -152 to -90 | (1)<br><br>AO1 |

| Question number | Answer                                                 | Mark       |
|-----------------|--------------------------------------------------------|------------|
| 4(a)(i)         | to clean the wire / to prevent contamination of sample | (1)<br>AO1 |

| Question number | Answer                                                                           | Mark       |
|-----------------|----------------------------------------------------------------------------------|------------|
| 4(a)(ii)        | so that the solid vaporises more easily / so that the solid sticks onto the wire | (1)<br>AO1 |

| Question number | Answer                                                                                                                                                                      | Mark       |
|-----------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|
| 4(a)(iii)       | A blue-green<br><br>B is incorrect as potassium gives a lilac flame<br>C is incorrect as calcium gives an orange-red flame<br>D is incorrect as sodium gives a yellow flame | (1)<br>AO2 |

| Question number | Answer                                 | Additional guidance                         | Mark       |
|-----------------|----------------------------------------|---------------------------------------------|------------|
| 4(b)(i)         | more {accurate / sensitive / reliable} | requires no judgement / can be quantitative | (1)<br>AO1 |

| Question number | Answer                                          | Mark       |
|-----------------|-------------------------------------------------|------------|
| 4(b)(ii)        | single straight line of best fit through points | (1)<br>AO3 |

| Question number | Answer                                             | Mark       |
|-----------------|----------------------------------------------------|------------|
| 4(b)(iii)       | value consistent with candidate's line of best fit | (1)<br>AO3 |

| Question number | Answer                                                                                                                                  | Additional guidance                             | Mark       |
|-----------------|-----------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------|------------|
| 4(c)            | An explanation linking<br><br>use hydrochloric acid (rather than sulfuric acid) (1)<br><br>(as) sulfuric acid contains sulfate ions (1) | Allow nitric acid<br>allow use a different acid | (2)<br>AO3 |

| Question number | Answer                                                                                             | Mark           |
|-----------------|----------------------------------------------------------------------------------------------------|----------------|
| 4(d)            | $\frac{63.5}{159.5}$ ( = 0.39811912) (1)<br><br>$0.398 \times 100$ (= 39.811912) (1)<br><br>40 (1) | (3)<br><br>AO2 |

| Question number | Answer   | Mark       |
|-----------------|----------|------------|
| 5(a)(i)         | halogens | (1)<br>AO1 |

| Question number | Answer   | Additional guidance        | Mark       |
|-----------------|----------|----------------------------|------------|
| 5(a)(ii)        | astatine | allow At / At <sub>2</sub> | (1)<br>AO1 |

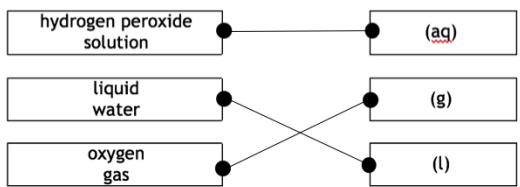
| Question number | Answer                                                                                                                                                                | Mark       |
|-----------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|
| 5(a)(iii)       | C bromine<br><br>A and B are not correct as they are gases at room temperature and pressure<br>D is not correct as iodine is a solid at room temperature and pressure | (1)<br>AO1 |

| Question number | Answer                                                                                                                                                                                                                                                     | Mark       |
|-----------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|
| 5(a)(iv)        | D iodine<br><br>A is not correct as fluorine is pale yellow at room temperature and pressure<br>B is not correct as chlorine is green at room temperature and pressure<br>C is not correct as bromine is red-brown liquid at room temperature and pressure | (1)<br>AO1 |

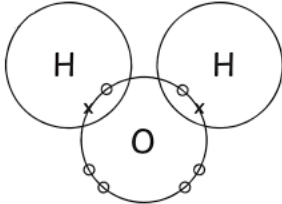
| Question number | Answer                                                                                               | Additional guidance | Mark       |
|-----------------|------------------------------------------------------------------------------------------------------|---------------------|------------|
| 5(b)            | $\frac{1.19}{119}$ and $\frac{1.42}{35.5}$ (1)<br><br>0.01 : 0.04 (1)<br><br>SnCl <sub>4</sub> . (1) | allow ECF           | (3)<br>AO2 |

| Question number | Answer                                                                                                                         | Additional guidance                                                                      | Mark       |
|-----------------|--------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------|------------|
| 5(c)            | An explanation linking<br><br>fluorine has fewer electron shells (1)<br><br>(so) electron more easily attracted to nucleus (1) | allow less shielding (1)<br>ignore fewer electrons<br>ignore fewer outer electron shells | (2)<br>AO1 |

| Question number | Answer                             | Additional guidance                                            | Mark       |
|-----------------|------------------------------------|----------------------------------------------------------------|------------|
| 6(a)(i)         | hydrogen peroxide → water + oxygen | allow symbol equation if all symbols and balancing are correct | (1)<br>AO2 |

| Question number | Answer                                                                                                                                | Additional guidance   | Mark       |
|-----------------|---------------------------------------------------------------------------------------------------------------------------------------|-----------------------|------------|
| 6(a)(ii)        |  <p>(2)</p> <p>all correct (2)<br/>1 correct (1)</p> | reject multiple lines | (2)<br>AO1 |

| Question number | Answer                                                                 | Additional guidance     | Mark       |
|-----------------|------------------------------------------------------------------------|-------------------------|------------|
| 6(b)            | A description to include<br><br>glowing splint (1)<br><br>relights (1) | MP2 is dependent on MP1 | (2)<br>AO1 |

| Question number | Answer                                                                                                                                                                                                             | Additional guidance                        | Mark       |
|-----------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------|------------|
| 6(c)            |  <p>(2)</p> <p>OR</p> <p>shared pair of electrons between the oxygen and a hydrogen (1)</p> <p>rest of molecule correct (1)</p> | allow dots or crosses or a mixture of both | (2)<br>AO1 |

| Question number | Answer          | Additional guidance   | Mark       |
|-----------------|-----------------|-----------------------|------------|
| 6(d)(i)         | Time in {s/min} | allow seconds/minutes | (1)<br>AO3 |

| Question number | Answer                                                                                                      | Additional guidance | Mark           |
|-----------------|-------------------------------------------------------------------------------------------------------------|---------------------|----------------|
| 6(d)(ii)        | A description to include reaction is faster with liver (1)<br><br>more {gas/oxygen} produced with liver (1) | allow ORA           | (2)<br><br>AO3 |

| Question number | Answer                                                                                                                                              | Mark           |
|-----------------|-----------------------------------------------------------------------------------------------------------------------------------------------------|----------------|
| 6(d)(iii)       | A description to include<br><br>bung and delivery tube (1)<br><br>connected to {a gas syringe / upturned burette / upturned measuring cylinder} (1) | (2)<br><br>AO3 |

| Question number | Answer                                                                                         | Additional guidance                                            | Mark                  |
|-----------------|------------------------------------------------------------------------------------------------|----------------------------------------------------------------|-----------------------|
| 7(a)(i)         | <p>(2)</p> <p>OR</p> <p>hydroxyl group on a carbon (1)</p> <p>rest of molecule correct (1)</p> | <p>allow OH for O-H</p> <p>reject any multiple bonds drawn</p> | <p>(2)</p> <p>AO1</p> |

| Question number | Answer                                                                                                  | Mark                  |
|-----------------|---------------------------------------------------------------------------------------------------------|-----------------------|
| 7(a)(ii)        | <p><b>C</b> it is oxidised</p> <p><b>A, B and D</b> are incorrect as this is an oxidation reaction.</p> | <p>(1)</p> <p>AO2</p> |

| Question number | Answer                                                                                | Mark                  |
|-----------------|---------------------------------------------------------------------------------------|-----------------------|
| 7(b)(i)         | <p>0.39 with or without working scores 1 mark</p> <p>152.62 – 152.23 (= 0.39) (1)</p> | <p>(1)</p> <p>AO2</p> |

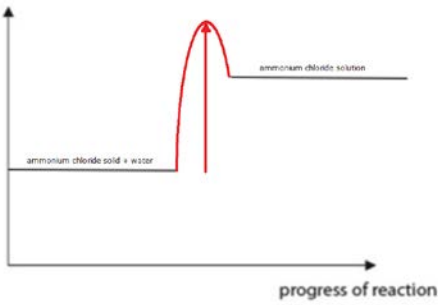
| Question number | Indicative content                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Mark |
|-----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|
| *7(b)(ii)       | <p>Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme. The indicative content below is not prescriptive and candidates are not required to include all the material that is indicated as relevant. Additional content included in the response must be scientific and relevant.</p> <p><b>AO1 (6 marks)</b></p> <ul style="list-style-type: none"> <li>• measure 100 cm<sup>3</sup> of water into a beaker.</li> <li>• place the beaker above the burner</li> <li>• place draft shields around the equipment</li> <li>• weigh the (alcohol) burner containing the alcohol</li> <li>• record this mass and the name of the alcohol.</li> <li>• place a thermometer in the water</li> <li>• record the initial temperature of the water</li> <li>• place a lid on beaker</li> <li>• light the wick.</li> <li>• heat the water so the temperature rises by 20°C.</li> <li>• extinguish the flame.</li> <li>• re-weigh the (alcohol) burner</li> <li>• subtract final mass from initial mass of burner and alcohol/ calculate the mass of alcohol used.</li> <li>• repeat with the next alcohol</li> <li>• using same volume of water</li> <li>• keep the height of the beaker the same</li> </ul> | (6)  |

| Level   | Mark | Descriptor                                                                                                                                                                                                                                                                                                                                                |
|---------|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|         | 0    | No rewardable material.                                                                                                                                                                                                                                                                                                                                   |
| Level 1 | 1–2  | Heat the water by 20°C and then subtract the final mass from the initial mass of the burner and alcohol                                                                                                                                                                                                                                                   |
| Level 2 | 3–4  | Measure 100 cm <sup>3</sup> of water into a conical flask, allow the alcohol to heat the water so the temperature rises by about 20°C. re-weigh the spirit burner and cap then calculate the mass of alcohol used.                                                                                                                                        |
| Level 3 | 5–6  | Measure 100 cm <sup>3</sup> of water into a conical flask/beaker. Weigh the burner and cap containing the alcohol. Record the initial temperature of the water in the flask. Allow the alcohol to heat the water so the temperature rises by about 20°C. Re-weigh the spirit burner and cap, subtract final mass from initial mass of burner and alcohol. |

| Question number | Answer                                                                                                               | Mark                         |
|-----------------|----------------------------------------------------------------------------------------------------------------------|------------------------------|
| 7(b)(iii)       | <p>0.02 with or without working scores 2 marks</p> <p><math>\frac{0.36}{20} = (0.018)</math> (1)</p> <p>0.02 (1)</p> | <p>(2)</p> <p><b>AO2</b></p> |

| Question number | Answer                                                                                                                                                                                                                                                                                                     | Additional guidance         | Mark       |
|-----------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------|------------|
| 8(a)            | <p>46.25 / 46 with or without working scores 2 marks</p> <p><math>\frac{200}{1000} (1) = 0.200 \text{ (dm}^3\text{)}</math></p> <p><math>\frac{9.25}{0.200} (1) = 46.25 / 46</math></p> <p>OR</p> <p><math>\frac{9.25}{200} = (0.04625) (1)</math></p> <p><math>0.04625 \times 1000 = 46.25 (1)</math></p> | answer to 2 or more sig fig | (2)<br>AO2 |

| Question number | Answer                                                                                                                                                                                                                                                                                                                                          | Additional guidance                                | Mark       |
|-----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------|------------|
| 8(b)(i)         | <p>an explanation linking two of:</p> <ul style="list-style-type: none"> <li>{ammonium chloride solution/product} has more energy than {ammonium chloride solid and water/reactant} / ORA (1)</li> <li>heat (energy) has increased / energy change is positive (1)</li> <li>(therefore) heat energy has been {absorbed/taken in} (1)</li> </ul> | ignore arguments about bond making / bond breaking | (2)<br>AO3 |

| Question number | Answer                                                                                                                                                                                                                 | Additional guidance                                                                                                                           | Mark       |
|-----------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------|------------|
| 8(b)(ii)        | <p>heat energy</p>  <p>ammonium chloride solid + water</p> <p>ammonium chloride solution</p> <p>progress of reaction</p> <p>(2)</p> | <p>curve from reactants to products with peak higher than product energy (1)</p> <p>arrow labelled activation energy on correct curve (1)</p> | (2)<br>AO2 |

| Question number | Answer                                                                                                                                                                                                                                                                                                                            | Additional guidance                                         | Mark       |
|-----------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------|------------|
| 8(c)            | <p>An explanation linking</p> <ul style="list-style-type: none"> <li>ammonium chloride solution conducts electricity and solid ammonium chloride does not conduct electricity (1)</li> <li>ammonium chloride contains <b>ions</b> (1)</li> <li>in solution <b>ions</b> can move / in solid <b>ions</b> cannot move (1)</li> </ul> | Answer must refer to both solid and solution for full marks | (3)<br>AO3 |

| Question number | Answer                                                                                                                                                                                                                                                                                                            | Mark       |
|-----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|
| 8(d)(i)         | <p>D</p>  <p>A is incorrect as it is the symbol for flammable substances.<br/>B is incorrect as it is the symbol for corrosive substances.<br/>C is incorrect as it is the symbol for substances that are harmful to health.</p> | (1)<br>AO1 |

| Question number | Answer              | Additional guidance                                     | Mark       |
|-----------------|---------------------|---------------------------------------------------------|------------|
| 8(d)(ii)        | use a fume cupboard | ignore wear PPE / masks<br>ignore wear goggles / gloves | (1)<br>AO1 |

| Question number | Answer                                             | Mark              |
|-----------------|----------------------------------------------------|-------------------|
| 9(a)            | <b>fractional</b> distillation / fractionation (1) | (1)<br><b>AO1</b> |

| Question number | Answer                                                                                                                                                                               | Mark              |
|-----------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|
| 9(b)            | <b>C</b> they have the same general formula<br><br><b>A, B</b> and <b>D</b> not correct as compounds in homologous series have different chemical, empirical and molecular formulae. | (1)<br><b>AO1</b> |

| Question number | Answer                                                                                     | Additional guidance             | Mark              |
|-----------------|--------------------------------------------------------------------------------------------|---------------------------------|-------------------|
| 9(c)            | $\text{N}_2 + 2\text{O}_2 \rightarrow 2\text{NO}_2$ (2)<br><br>or<br><br>$\text{NO}_2$ (1) | other incorrect balancing max 1 | (2)<br><b>AO2</b> |

| Question number | Answer                                                                                                                                                                                                               | Additional guidance                       | Mark              |
|-----------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------|-------------------|
| 9(d)            | An explanation linking <ul style="list-style-type: none"> <li>{carbon dioxide / water} produced (1)</li> <li>(the gases) absorb heat radiated from earth (1)</li> </ul> re-radiate heat back into the atmosphere (1) | allow formula<br><br>allow traps the heat | (3)<br><b>AO2</b> |

| Question num | Indicative content                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Mark |
|--------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|
| 9(e)         | <p>Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme. The indicative content below is not prescriptive and candidates are not required to include all the material that is indicated as relevant. Additional content included in the response must be scientific and relevant.</p> <p><b>AO1 (3 marks) AO2 (3 marks)</b></p> <ul style="list-style-type: none"> <li>• sulfur burns at the same time as the hydrocarbon</li> <li>• sulfur reacts with oxygen</li> <li>• sulfur dioxide gas is formed</li> <li>• sulfur dioxide is an acidic gas</li> <li>• sulfur dioxide dissolves in clouds</li> <li>• to form sulfurous acid</li> <li>• which is then oxidised to form sulfuric acid</li> <li>• rain water becomes acidic</li> <li>• acid rain damages buildings / statues</li> <li>• damages plants/trees</li> <li>• runs into rivers / waterways</li> <li>• makes rivers/waterways acidic</li> <li>• kills fish/insects/waterlife</li> <li>• increases corrosion of metals</li> </ul> | (6)  |

| Level   | Mark | Descriptor                                                                                                                                                                                |
|---------|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|         | 0    | No rewardable material.                                                                                                                                                                   |
| Level 1 | 1–2  | acid rain damages plants and erodes buildings                                                                                                                                             |
| Level 2 | 3–4  | sulfur dioxide is formed which dissolves in clouds and then acid rain runs into waterways and kills fish                                                                                  |
| Level 3 | 5–6  | sulfur burns to form sulfur dioxide which dissolves in clouds to form sulfuric acid, the acid rains can erode limestone statues and will increase corrosion of metals making them weaker. |

| Question number | Answer                                                                                                                                                                                                                                                                                                                                                                                                      | Mark           |
|-----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|
| 10(a)(i)        | Any one from <ul style="list-style-type: none"> <li>• need to sort polymers into different types</li> <li>• polymers often need to be separated from other polymers</li> <li>• takes time to sort by hand</li> <li>• containers may need to be washed before recycling</li> <li>• difficult to break down into their monomers</li> <li>• some not recyclable</li> <li>• requires a lot of energy</li> </ul> | (1)<br><br>AO1 |

| Question number | Answer                                                                                                                                                                                                                                                                                                | Additional guidance                                                                                       | Mark           |
|-----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------|----------------|
| 10(a)(ii)       | A description to include <ul style="list-style-type: none"> <li>• polymers persist in landfill / landfill site fills up too quickly</li> <li>• polymers degrade very slowly</li> </ul> or <ul style="list-style-type: none"> <li>• combustion produces gases</li> <li>• which may be toxic</li> </ul> | accept polymers persist in the environment / harmful to wildlife<br>not biodegradable / hard to decompose | (2)<br><br>AO1 |

| Question number | Answer            | Additional guidance   | Mark           |
|-----------------|-------------------|-----------------------|----------------|
| 10(b)(i)        | circle around C=C | or circle around C-Cl | (1)<br><br>AO2 |

| Question number | Answer                                                                                                                                                                                                                                                                                                              | Additional guidance                                                                                                                                                                                                                                                                                            | Mark           |
|-----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|
| 10(b)(ii)       | $  \begin{array}{cccccc}  \text{H} & \text{Cl} & \text{H} & \text{Cl} & \text{H} & \text{Cl} \\    &   &   &   &   &   \\  -\text{C} & -\text{C} & -\text{C} & -\text{C} & -\text{C} & -\text{C}- \\    &   &   &   &   &   \\  \text{H} & \text{H} & \text{H} & \text{H} & \text{H} & \text{H}  \end{array}  $ (3) | chain containing 6 C atoms (1)<br>single bonds between C atoms (1)<br>rest of structure complete (1)<br><br>allow alternative arrangements<br><br>allow max 2 for $  \left[ \begin{array}{cc} \text{H} & \text{Cl} \\   &   \\ -\text{C} & -\text{C}- \\   &   \\ \text{H} & \text{H} \end{array} \right]_3  $ | (3)<br><br>AO1 |

| Question number | Answer             | Mark           |
|-----------------|--------------------|----------------|
| 10(b)(iii)      | addition (polymer) | (1)<br><br>AO1 |

| Question number  | Answer                                                                                                                | Additional guidance                                                                                      | Mark                         |
|------------------|-----------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------|------------------------------|
| <b>10(b)(iv)</b> | relative formula mass $C_2H_3Cl = 62.5$ (1)<br><br>$2850 \times 62.5$ (1) (=178125)<br><br>178000 (to 3 sig figs) (1) | without working<br>178000 (3)<br>178125 / 178127 (2)<br><br>allow ECF on incorrect relative formula mass | <b>(3)</b><br><br><b>AO2</b> |

