# GCSE

## CHEMISTRY

### Higher Tier Paper 2

**Mark scheme** Practice Paper Series – Set 2 SGC/S2/SC/2H

Version 1.1 - reviewed 26 October 2026

This mark scheme is an original resource written for sciencegcse.co.uk to accompany the Set 2 practice paper SGC/S2/SC/2H. It is not an AQA mark scheme and has not been produced or endorsed by AQA. It follows the structure and conventions of AQA GCSE science mark schemes so that students and teachers can mark the practice paper in the same way that a real paper is marked.

Marking should be carried out using the Information to Examiners on the following pages. The paper has not been standardised, so raw marks should not be converted into grades using any published grade boundaries.

Specification references are to the AQA GCSE Chemistry (8462) specification, sections 4.6–4.10 (Paper 2 may also draw on sections 4.1–4.3). AO = assessment objective; WS = working scientifically; MS = mathematical skills; RP = required practical.

# 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 answer(s) expected, including alternative acceptable wording, in the **Answers** column
- guidance on which answers are and are not creditworthy in the **Extra information** column
- the assessment objective (AO) and specification reference for each marking point.

Award marks positively. Do not deduct marks for incorrect additional material unless it contradicts a correct answer (see 3.1). Marks are awarded for what the student has written, not for what they might have meant.

## 2. Emboldening and underlining

2.1 Where a list of acceptable answers is given and more than one mark is available, **any two from** (or similar) is used, followed by the acceptable answers.

2.2 A bold **and** indicates that both parts of the answer are needed to gain the mark.

2.3 Alternative answers acceptable for the same mark are separated by **or**. Different words that are acceptable within a marking point are separated by a forward slash (/).

2.4 Words in bold in the Answers column are the essential words that must be present, or their equivalent, for the mark to be awarded.

## 3. Marking points

**3.1 Marking of lists**
When a fixed number of responses is requested but extra responses are given, consider the whole list. Each incorrect response or contradiction cancels one otherwise available correct response, up to the mark limit; the score cannot fall below zero. Neutral material identified by **ignore** does not cancel a correct response. Do not apply this rule as a penalty for extra relevant detail in an extended answer.

**3.2 Marking procedure for calculations**
A correct final answer can receive the marks indicated in the question-specific scheme without every intermediate step being written. Do not award full marks if the working shown contradicts that answer. Where the question specifically requires a method, demonstration or working, apply that requirement. Credit correct stages when the final answer is wrong, including consequential steps where permitted. A printed unit may only be replaced by another unit when the numerical value is converted consistently.

**3.3 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.

**3.4 Errors carried forward**
Use an earlier incorrect value in a later part where ECF is allowed by the question-specific scheme. Within a calculation, credit later correct stages that use an earlier incorrect value consistently, subject to any stated limits. Do not repeatedly penalise the same error.

**3.5 Phonetic spelling**
Accept a misspelling when the intended scientific term is clear, including when a term is being recalled. Do not accept wording that could instead name a different scientific term.

**3.6 Brackets**
Words shown in brackets in the Answers column are not required to gain the mark but help to set the context.

**3.7 Allow**
Answers that are acceptable but which would not normally be expected are shown as **allow**.

**3.8 Ignore**
Statements shown as **ignore** are neither creditworthy nor penalised. Mark the rest of the answer normally.

**3.9 Do not accept**
Statements shown as **do not accept** are incorrect and, where they contradict or replace the expected answer, mean the mark is not awarded.

## 4. Level of response marking instructions

Extended-response questions (questions 02.1 and 05.6 in this paper) are marked using a level of response mark scheme. The scheme has three levels, each covering two marks, plus a level descriptor and indicative content.

**Step 1 – Determine a level.** Read the whole answer and decide which level descriptor best fits it. Use a 'best-fit' approach: an answer does not need to meet every part of a descriptor to be placed in that level, and a weak part of the answer need not prevent it from reaching the higher level if the overall quality matches the descriptor.

**Step 2 – Determine a mark within the level.** Award the higher mark in the level if the answer meets the descriptor fully and the points made are well linked; award the lower mark if the answer only just meets the descriptor or contains minor errors or omissions.

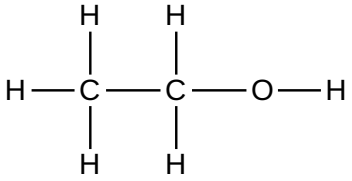
The indicative content is not a checklist: students need not include every point to reach the top level, and other relevant, correct points should be credited. An answer that lists points without linking them into a coherent answer should be placed in a lower level than one that develops and connects them.

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **01.1** | glass fibres: reinforcement that makes the material strong | allow makes it stiff / hard to bend | 1 | AO1<br>4.10.3.3 |
| | polymer resin: matrix / binder that holds the fibres together | allow binds the fibres together | 1 | AO1<br>4.10.3.3 |
| **01.2** | different reaction conditions / a different catalyst are used | allow LD poly(ethene) is made at a high pressure, HD poly(ethene) at a lower pressure with a catalyst<br>allow a different temperature or pressure<br>ignore made from a different monomer | 1 | AO1<br>4.10.3.3 |
| **01.3** | a thermosoftening polymer is made of separate polymer chains with no cross-links | | 1 | AO1<br>4.10.3.3 |
| | the forces between the chains are weak, so they are overcome when the polymer is heated and the chains can move past each other | allow intermolecular forces<br>do not accept covalent bonds break when it melts | 1 | AO1<br>4.10.3.3 |
| | a thermosetting polymer has (covalent) cross-links between the chains, which do not break when it is heated, so it does not melt | allow the chains are held in place by strong cross-links | 1 | AO1<br>4.10.3.3 |
| **01.4** | **P** is not suitable because it can only be used up to 100 °C, which is below 170 °C | | 1 | AO3<br>4.10.3.3 |
| | cost for each use correct for **R** and at least one other material: **P** £1.60, **Q** £3.75, **R** £1.20 | | 1 | AO2<br>4.10.3.3<br>MS 1a |
| | so **R** (steel) should be used: it can be used at 170 °C and it has the lowest cost for each use | allow ECF from incorrect costs for each use<br>allow R costs less for each use than P | 1 | AO3<br>4.10.3.3 |
| | | **Total** | **9** | |

<table>
<tr><th>Question</th><th>Answers</th><th>Extra information</th><th>Mark</th><th>AO / Spec. Ref.</th></tr>
<tr><td>02.1</td><td colspan="2"><table>
<tr><td>Level 3<br>(5–6 marks)</td><td>A coherent method is described with relevant detail, which demonstrates a broad understanding of the techniques and procedures. The steps are in a logical order and would give valid results: the concentration is changed by mixing different volumes of the sodium thiosulfate solution with water to the same total volume, the same volume of acid is used, and the time for the cross to disappear is measured for each concentration.</td></tr>
<tr><td>Level 2<br>(3–4 marks)</td><td>The bulk of a method is described with mostly relevant detail. The method may not be in a completely logical order and may be missing some detail, for example how the concentration is changed or which variables are kept the same.</td></tr>
<tr><td>Level 1<br>(1–2 marks)</td><td>Simple statements are made about some of the steps, for example add acid to the sodium thiosulfate and time how long the cross takes to disappear. The response may lack a logical structure and would not give valid results.</td></tr>
<tr><td>0 marks</td><td>No relevant content.</td></tr>
</table></td><td></td><td>6</td><td>AO1<br>4.6.1.2<br>RP</td></tr>
<tr><td></td><td colspan="2">Indicative content<br>• measure a volume of sodium thiosulfate solution with a measuring cylinder, e.g. 10 $cm^3$<br>• add water to make the total volume 50 $cm^3$<br>• put the mixture in the conical flask and put the flask on the cross<br>• measure a fixed volume of hydrochloric acid with a different measuring cylinder, e.g. 10 $cm^3$<br>• add the acid to the flask, swirl, and start the stopwatch at the same time<br>• look down through the mixture from above<br>• stop the stopwatch when the cross can no longer be seen<br>• repeat with different volumes of sodium thiosulfate solution, e.g. 10, 20, 30, 40 and 50 $cm^3$, each made up to 50 $cm^3$ with water<br>• keep the volume and concentration of the acid, the total volume, the temperature and the cross the same<br>• the same person should judge when the cross disappears<br>• repeat each concentration and calculate a mean time<br>• rinse the flask between experiments<br>• work in a well-ventilated room because sulfur dioxide is produced / wear eye protection<br>To reach Level 3 the method must change the concentration by dilution to the same total volume (or another valid way), keep the volume of acid the same and time how long the cross takes to disappear.</td><td></td><td></td></tr>
<tr><td>02.2</td><td>(29 + 31) ÷ 2</td><td>an answer of 30 (s) scores 2 marks</td><td>1</td><td>AO2<br>4.6.1.2<br>RP<br>MS 2b</td></tr>
</table>

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| | = **30** (s) | an answer of 32.7 (the anomalous result included) scores 1 mark | 1 | AO2<br>4.6.1.2<br>RP<br>MS 2b |
| **02.3** | point plotted correctly at (20, 60) | allow ± half a small square | 1 | AO2<br>4.6.1.2<br>RP<br>MS 4a, 4c |
| | point plotted correctly at (40, 30) | allow ECF from 02.2<br>allow ± half a small square | 1 | AO2<br>4.6.1.2<br>RP<br>MS 4a, 4c |
| | a smooth curve of best fit that passes through or close to all the points | do not accept points joined dot to dot or a straight line | 1 | AO2<br>4.6.1.2<br>RP<br>MS 4a, 4c |
| **02.4** | (at a higher concentration) there are more (reacting) particles in the same volume | do not accept the particles move faster | 1 | AO1<br>4.6.1.3 |
| | so the particles collide more frequently | allow more collisions per second / more successful collisions per second<br>ignore more collisions unless linked to time | 1 | AO1<br>4.6.1.3 |
| **02.5** | yes: the mean time for 50 g/dm$^3$ (25 s) is shorter than the mean time for 40 g/dm$^3$ (30 s) | allow ECF from 02.2 | 1 | AO3<br>4.6.1.2<br>RP<br>WS 3.5, 3.7 |
| | the repeat results do not overlap (24–26 s and 29–31 s), supporting a difference in rate under these conditions | allow the difference between the means is bigger than the spread of the repeats<br>ignore the anomalous result (38 s) | 1 | AO3<br>4.6.1.2<br>RP<br>WS 3.5, 3.7 |
| | | **Total** | **15** | |
| **03.1** | sulfur in the coal reacts with oxygen (from the air) | allow the sulfur is oxidised<br>allow S + $O_2$ → $SO_2$ | 1 | AO1<br>4.9.3.1 |
| **03.2** | environment: acid rain | allow damage to buildings / trees / water life caused by acid rain | 1 | AO1<br>4.9.3.2 |
| | human health: respiratory problems | allow breathing problems / asthma / irritates the lungs | 1 | AO1<br>4.9.3.2 |
| **03.3** | moles of $SO_2$ = 4 000 000 ÷ 64 = 62 500 (mol) | an answer of 1.5 × 10$^6$ (dm$^3$) scores **3** marks | 1 | AO2<br>4.3.5 (HT)<br>MS 1a, 1b |
| | moles of $CO_2$ = 62 500 (mol) | allow ECF from an incorrect number of moles | 1 | AO2<br>4.3.5 (HT)<br>MS 1a, 1b |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| | volume = 62 500 × 24 = **$1.5 \times 10^6$** ($dm^3$) | an answer of 1 500 000 ($dm^3$) scores 2 marks<br>allow $1.5 \times 10^3$ $m^3$ only if the printed unit is changed to $m^3$ | 1 | AO2<br>4.3.5 (HT)<br>MS 1a, 1b |
| **03.4** | less carbon dioxide is released into the atmosphere, so its concentration increases less | ignore it is stored underground on its own (given in the question) | 1 | AO2<br>4.9.2.1, 4.9.2.4 |
| | less outgoing infrared radiation is absorbed and re-emitted by greenhouse gases, reducing the enhanced greenhouse effect | allow more infrared radiation escapes to space | 1 | AO2<br>4.9.2.1, 4.9.2.4 |
| **03.5** | the carbon dioxide released by removing the sulfur dioxide (about 3 tonnes) is very small compared with the carbon dioxide from burning the coal (800 tonnes) | | 1 | AO3<br>4.9.3.2<br>WS 1.4 |
| | removing the sulfur dioxide prevents acid rain / respiratory problems, so the statement is not justified | allow the benefit of removing the sulfur dioxide is greater than the harm of the extra carbon dioxide | 1 | AO3<br>4.9.3.2<br>WS 1.4 |
| | | **Total** | **10** | |
| **04.1** | **W**: copper(II) sulfate | allow copper sulfate<br>both ions must be correct for each mark | 1 | AO2<br>4.8.3.1–4.8.3.5<br>RP |
| | **X**: iron(III) chloride | allow iron chloride<br>do not accept iron(II) chloride | 1 | AO2<br>4.8.3.1–4.8.3.5<br>RP |
| | **Y**: lithium carbonate | | 1 | AO2<br>4.8.3.1–4.8.3.5<br>RP |
| | **Z**: potassium bromide | | 1 | AO2<br>4.8.3.1–4.8.3.5<br>RP |
| **04.2** | $Br^-$(aq) on the left | ignore state symbols<br>do not accept Br or $Br_2$ | 1 | AO2<br>4.8.3.4<br>4.1.1.1 (HT) |
| | AgBr on the right | allow ECF from an incorrect halide ion in 04.1 | 1 | AO2<br>4.8.3.4<br>4.1.1.1 (HT) |
| **04.3** | to react with / remove carbonate ions (which would also give a precipitate with silver nitrate) | allow to remove ions that would give a false positive result | 1 | AO1<br>4.8.3.4 |
| **04.4** | hydrochloric acid contains chloride ions, which would give a white precipitate with silver nitrate | allow it would give a false positive result for chloride ions | 1 | AO2<br>4.8.3.4 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **04.5** | dip a clean (nichrome / platinum) wire loop into solution **W** | allow moisten the loop with acid and dip it into the solid | 1 | AO1<br>4.8.3.1<br>RP |
| | hold the loop in a (blue / roaring) Bunsen burner flame and observe the colour of the flame | | 1 | AO1<br>4.8.3.1<br>RP |
| **04.6** | the gas was not identified / the gas could be a different gas | allow other substances also give bubbles with acid | 1 | AO3<br>4.8.3.3<br>WS 3.5 |
| | bubble the gas through limewater: it turns milky / cloudy if the gas is carbon dioxide | both the test and the result are needed for this mark | 1 | AO1<br>4.8.2.3 |
| | | **Total** | **12** | |
| **05.1** |  | all the atoms and all the bonds must be shown, including the O–H bond | 1 | AO1<br>4.7.2.3 |
| **05.2** | any **two** from:<br>• bubbles / fizzing<br>• the sodium gets smaller / disappears<br>• the sodium sinks | ignore hydrogen is produced (not an observation)<br>ignore the sodium dissolves | 2 | AO1<br>4.7.2.3 |
| **05.3** | ethanoic acid | do not accept a carboxylic acid on its own<br>do not accept ethanol / ethene | 1 | AO1<br>4.7.2.3 |
| **05.4** | any **three** from:<br>• yeast<br>• a warm temperature (about 30 °C)<br>• no air / oxygen (anaerobic)<br>• the sugar is dissolved in water | allow a temperature between 20 °C and 40 °C<br>ignore hot<br>do not accept a temperature above 40 °C | 3 | AO1<br>4.7.2.3 |
| **05.5** | mass of glucose fermented = 45.0 × 0.800 = 36.0 (kg) | an answer of 18.4 (kg) scores **4** marks | 1 | AO2<br>4.3.2.2 (HT)<br>MS 1a, 1c |
| | moles of glucose = 36 000 ÷ 180 = 200 (mol) | allow the mass-ratio method: 180 kg of glucose gives 2 × 46 = 92 kg of ethanol | 1 | AO2<br>4.3.2.2 (HT)<br>MS 1a, 1c |
| | moles of ethanol = 2 × 200 = 400 (mol) | | 1 | AO2<br>4.3.2.2 (HT)<br>MS 1a, 1c |
| | mass of ethanol = 400 × 46 = 18 400 g = **18.4** (kg) | allow ECF from earlier steps<br>an answer of 23.0 (kg) (80% not used) scores 3 marks<br>an answer of 9.2 (kg) (1 : 2 ratio not used) scores 3 marks | 1 | AO2<br>4.3.2.2 (HT)<br>MS 1a, 1c |

<table>
<tr><th>Question</th><th>Answers</th><th>Extra information</th><th>Mark</th><th>AO / Spec. Ref.</th></tr>
<tr><td>05.6</td><td colspan="2"><table>
<tr><td>Level 3 (5–6 marks)</td><td>A detailed evaluation that compares the two methods using several points from the table and own knowledge, with the advantages and disadvantages of each method linked together, leading to a justified conclusion.</td></tr>
<tr><td>Level 2 (3–4 marks)</td><td>Some advantages and disadvantages of both methods are given, using some data from the table. A conclusion may be given but it is not fully justified.</td></tr>
<tr><td>Level 1 (1–2 marks)</td><td>Simple statements about one or both methods, for example fermentation is slow, or ethene comes from crude oil.</td></tr>
<tr><td>0 marks</td><td>No relevant content.</td></tr>
</table></td><td></td><td>6</td><td>AO3<br>4.7.2.2, 4.7.2.3<br>WS 1.4</td></tr>
<tr><td></td><td colspan="2">Indicative content<br>• sugar cane is a renewable resource: it can be grown again<br>• crude oil is a finite (non-renewable) resource, so ethene will run out<br>• growing sugar cane uses land that could be used to grow food<br>• fermentation needs little energy (low temperature, normal pressure), so less fuel is burned and less carbon dioxide is released<br>• the reaction of ethene with steam needs a high temperature and pressure, which use a lot of energy and are expensive<br>• the reaction of ethene with steam is fast and continuous, so more ethanol is made in a given time<br>• fermentation is slow and is a batch process, so less ethanol is made in a given time<br>• fermentation gives a dilute solution, so the ethanol must be separated (by fractional distillation), which needs energy<br>• the reaction of ethene with steam gives almost pure ethanol<br>• fermentation has a lower atom economy (51%) because carbon dioxide is also produced, so more of the starting materials end up as waste<br>• the carbon dioxide from fermentation was taken in by the sugar cane as it grew<br>• the reaction of ethene with steam has an atom economy of 100%: ethanol is the only product<br>• a justified conclusion, e.g. fermentation is more sustainable, but the reaction of ethene with steam is better for making large amounts of pure ethanol quickly<br>To reach Level 3 the answer must consider both methods, use data from the table and give a justified conclusion. Any reasoned conclusion can be credited.</td><td></td><td></td></tr>
<tr><td colspan="3">Total</td><td>17</td><td></td></tr>
<tr><td>06.1</td><td>any two from:<br>• the solution is put into a (hot) flame<br>• the light given out is passed through a spectroscope / is split up to give a line spectrum<br>• the spectrum is compared with the spectra of known metal ions (reference spectra)</td><td>allow each metal ion gives a different / unique spectrum</td><td>2</td><td>AO1<br>4.8.3.7</td></tr>
</table>

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **06.2** | point plotted correctly at (20, 40) | allow ± half a small square | 1 | AO2<br>4.8.3.7<br>MS 4a, 4c |
| | point plotted correctly at (40, 76) | allow ± half a small square | 1 | AO2<br>4.8.3.7<br>MS 4a, 4c |
| | a straight line of best fit through or close to all the points | do not accept a line forced through the origin | 1 | AO2<br>4.8.3.7<br>MS 4a, 4c |
| **06.3** | any **two** from:<br>• more sensitive / detects lower concentrations<br>• more accurate or precise<br>• faster<br>• can distinguish ions in mixtures / provides a unique line spectrum for each ion | ignore easier / better without explanation | 2 | AO1<br>4.8.3.6, 4.8.3.7 |
| **06.4** | any **one** from:<br>• the deionised water / solution contains a very small amount of sodium ions<br>• the instrument detects some light from the flame itself | allow the instrument was not set to zero | 1 | AO2<br>4.8.3.7 |
| **06.5** | dilute the sample with deionised water to bring it within the calibration range | allow measure a known volume and make up to a larger known volume with deionised water; account for the dilution factor when finding the original concentration<br>calibration limit is 50 mg/dm$^3$ | 1 | AO3<br>4.8.3.7 |
| | | **Total** | **9** | |
| **07.1** | a tangent drawn to the curve at 100 s | | 1 | AO2<br>4.6.1.1 (HT)<br>MS 4e, 1b |
| | gradient calculated from the tangent (change in amount ÷ change in time) | | 1 | AO2<br>4.6.1.1 (HT)<br>MS 4e, 1b |
| | $2.5 \times 10^{-3}$ to $3.3 \times 10^{-3}$ (mol/s) | the answer must be in standard form for this mark<br>a line that crosses the curve at 100 s is not a tangent | 1 | AO2<br>4.6.1.1 (HT)<br>MS 4e, 1b |
| **07.2** | (dynamic) equilibrium has been reached | do not accept the reaction has stopped | 1 | AO1<br>4.6.2.3 |
| | the forward and reverse reactions happen at the same rate | allow hydrogen iodide is made at the same rate as it decomposes | 1 | AO1<br>4.6.2.3 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **07.3** | a line that starts at the origin, is steeper at the start and levels off sooner | | 1 | AO2<br>4.6.2.6 (HT)<br>4.6.1.2 |
| | the line levels off at a lower amount of hydrogen iodide (below 0.78 mol) | do not accept a line that levels off higher | 1 | AO2<br>4.6.2.6 (HT)<br>4.6.1.2 |
| **07.4** | there are two molecules of gas on each side of the equation | allow the same number of moles of gas on both sides | 1 | AO2<br>4.6.2.7 (HT) |
| | so changing the pressure does not favour either reaction / does not move the position of equilibrium | | 1 | AO2<br>4.6.2.7 (HT) |
| **07.5** | the amount of iodine decreases | | 1 | AO2<br>4.6.2.5 (HT) |
| | (the position of) equilibrium moves to the right / the forward reaction is favoured, using up some of the added hydrogen | allow to reduce the concentration of hydrogen / to oppose the change | 1 | AO2<br>4.6.2.5 (HT) |
| | | **Total** | **11** | |
| **08.1** | water that is safe to drink | allow drinking water<br>do not accept pure water | 1 | AO1<br>4.10.1.2 |
| **08.2** | any **four** from:<br>• reverse osmosis needs less energy (4 kWh compared with 18 kWh for each $m^3$)<br>• reverse osmosis turns a greater percentage of the sea water into potable water (45% compared with 25%)<br>• distillation gives water with a lower concentration of dissolved salts (20 compared with 250 mg/$dm^3$)<br>• but both methods give water below the limit of 500 mg/$dm^3$, so both are suitable<br>• distillation can use waste heat from a power station, so it may not need extra fuel<br>• the membranes for reverse osmosis must be replaced, which costs money / produces waste<br>• a justified conclusion, e.g. reverse osmosis is better unless waste heat is available | to gain all 4 marks, both methods must be considered and data from the table must be used<br>max 3 marks if no justified conclusion is given | 4 | AO3<br>4.10.1.2 |
| **08.3** | 900 ÷ 0.45 / 900 × 100 ÷ 45 | an answer of 2000 ($m^3$) scores **2** marks | 1 | AO2<br>4.10.1.2<br>MS 1c |
| | = **2000** ($m^3$) | | 1 | AO2<br>4.10.1.2<br>MS 1c |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **08.4** | 50 $cm^3$ of the water contains only 12.5 mg (0.0125 g) of dissolved salts, which is too small a mass to measure accurately with this balance | allow the mass of solid would be about 0.01 g, so the percentage error would be very large | 1 | AO3<br>4.10.1.2<br>RP<br>WS 2.7, 3.7 |
| | evaporate a much larger volume of water, e.g. 1 $dm^3$ / use a more precise balance (e.g. to 0.001 g) | | 1 | AO3<br>4.10.1.2<br>RP<br>WS 2.7, 3.7 |
| | | **Total** | **9** | |
| **09.1** | any **two** from:<br>• giving values to the effects of pollutants needs value judgements / is subjective<br>• some values are difficult to measure or estimate<br>• an LCA may include only some of the stages (selective / abbreviated LCA)<br>• an LCA can be used to support a claim, e.g. in advertising | ignore LCAs are expensive | 2 | AO1<br>4.10.2.1 |
| **09.2** | energy for one paper cup = 350 + 200 + 20 = 570 (kJ) | an answer of 40 scores **3** marks | 1 | AO2<br>4.10.2.1<br>MS 1a, 3d |
| | energy for a mug used *n* times = 15 300 + 180*n* / energy saved on each use = 570 − 180 = 390 (kJ) | | 1 | AO2<br>4.10.2.1<br>MS 1a, 3d |
| | 15 300 ÷ 390 = 39.2, so the minimum number of uses is **40** | an answer of 39 or 39.2 scores 2 marks<br>allow a correct trial-and-improvement method, e.g. 40 uses: mug 22 500 kJ, paper cups 22 800 kJ<br>allow ECF from an incorrect total for one paper cup or for the one-off energy of the mug | 1 | AO2<br>4.10.2.1<br>MS 1a, 3d |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **09.3** | any **three** from:<br>• the statement is only true if each mug is used at least 40 times / a mug that breaks or is lost sooner is worse<br>• washing uses water and detergents / produces waste water, which is not included in the table<br>• the table only compares energy, not other impacts, e.g. use of raw materials or pollution<br>• paper cups are made from a renewable resource (wood)<br>• broken ceramic mugs cannot easily be recycled / go to landfill<br>• a justified conclusion, e.g. mugs are better only if they are reused many times | max 2 marks if no justified conclusion is given<br>ignore paper cups can be recycled / composted, unless qualified (most cups have a plastic lining) | 3 | AO3<br>4.10.2.1 |
| | | **Total** | **8** | |
| | | **TOTAL FOR PAPER** | **100** | |