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# GCSE CHEMISTRY 8462/2H

Paper 2 Higher Tier

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Mark scheme

June 2025

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Version: 1.0 Final



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.

No student should be disadvantaged on the basis of their gender identity and/or how they refer to the gender identity of others in their exam responses.

A consistent use of 'they/them' as a singular and pronouns beyond 'she/her' or 'he/him' will be credited in exam responses in line with existing mark scheme criteria.

Further copies of this mark scheme are available from [aqa.org.uk](http://aqa.org.uk)

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## 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 their judgement
- the Assessment Objectives 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 (for example, a scientifically correct answer that could not reasonably be expected from a student's knowledge of the specification).

### 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**.  
Alternative words in the mark scheme are shown by a solidus 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** magnetic materials.

[2 marks]

| Student | Response              | Marks awarded |
|---------|-----------------------|---------------|
| 1       | iron, steel, tin      | 1             |
| 2       | cobalt, nickel, nail* | 2             |

#### 3.2 Use of symbols / formulae

If a student writes a chemical symbol / formula instead of a required chemical name, or uses symbols to denote quantities in a physics equation, 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. At any point in a calculation students may omit steps from their working. If a subsequent step is given correctly, the relevant marks may be awarded.

Full marks should be awarded for a correct numerical answer, without any working shown. Full marks are **not** awarded for a correct final answer from incorrect working.

#### 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

An error can be carried forward from one question part to the next and is shown by the abbreviation 'ecf'.

Within an individual question part, an incorrect value in one step of a calculation does not prevent all of the subsequent marks being awarded.

### 3.6 Phonetic spelling

Marks should be awarded if spelling is not correct but the intention is clear, **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.

### 3.11 Numbered answer lines

Numbered lines on the question paper are intended to support the student to give the correct number of responses. The answer should still be marked as a whole.

## 4. Level of response marking instructions

Extended response questions are marked on level of response mark schemes.

- 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 two marks in each level.

Before you apply the mark scheme to a student's answer, read through the answer and, if necessary, 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. Do **not** look to penalise 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.

Use the variability of the response to help decide the mark within the level, ie if the response is predominantly level 2 with a small amount of level 3 material it would be placed in level 2 but be awarded a mark near the top of the level because of the level 3 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.

You should ignore any irrelevant points made. However, full marks can be awarded only if there are no incorrect statements that contradict a correct response.

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

**Question 1**

| Question    | Answers                                                     | Extra information                                               | Mark | AO / Spec. Ref.         |
|-------------|-------------------------------------------------------------|-----------------------------------------------------------------|------|-------------------------|
| <b>01.1</b> | (a burette is) more accurate<br>(than a measuring cylinder) | allow (a burette has) a higher resolution<br><br>ignore precise | 1    | AO3<br>4.10.1.2<br>RPA8 |

| Question    | Answers                        | Extra information | Mark | AO / Spec. Ref.         |
|-------------|--------------------------------|-------------------|------|-------------------------|
| <b>01.2</b> | the mass of (dissolved) solids |                   | 1    | AO1<br>4.10.1.2<br>RPA8 |

| Question    | Answers                                     | Extra information                                 | Mark | AO / Spec. Ref.         |
|-------------|---------------------------------------------|---------------------------------------------------|------|-------------------------|
| <b>01.3</b> | reheat (the evaporating basin and contents) |                                                   | 1    | AO3<br>4.10.1.2<br>RPA8 |
|             | (and reweigh) until constant mass           |                                                   | 1    |                         |
|             |                                             | allow for <b>2</b> marks<br>heat to constant mass |      |                         |

| Question    | Answers                                                                                                                               | Extra information                               | Mark | AO / Spec. Ref.         |
|-------------|---------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------|------|-------------------------|
| <b>01.4</b> | subtract the mass of the (empty) evaporating basin from the mass of the evaporating basin and contents (at the end of the experiment) | allow subtract initial mass from the final mass | 1    | AO1<br>4.10.1.2<br>RPA8 |

| Question | Answers                                                                                                               | Extra information                                                                    | Mark | AO / Spec. Ref.                    |
|----------|-----------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|------|------------------------------------|
| 01.5     | (allow mean mass =)<br>$\frac{0.35 + 0.37 + 0.33 + 0.34}{4}$                                                          | (allow mean mass =)<br>$\frac{1.39}{4}$                                              | 1    | AO2<br>4.3.2.5<br>4.10.1.2<br>RPA8 |
|          | = 0.3475 (g)                                                                                                          |                                                                                      | 1    |                                    |
|          | (conversion 10 cm <sup>3</sup> =) 0.01 dm <sup>3</sup>                                                                |                                                                                      | 1    |                                    |
|          | (mean concentration =) $\frac{0.3475}{0.01}$                                                                          | allow correct use of incorrectly determined mean mass                                | 1    |                                    |
|          |                                                                                                                       | allow correct use of incorrect / no conversion of volume                             |      |                                    |
|          | = 34.75 (g/dm <sup>3</sup> )                                                                                          | allow 34.75 (g/dm <sup>3</sup> ) correctly rounded to at least 2 significant figures | 1    |                                    |
|          | <b>alternative approach 1</b>                                                                                         |                                                                                      |      |                                    |
|          | (conversion 10 cm <sup>3</sup> =)<br>0.01 dm <sup>3</sup> (1)                                                         |                                                                                      |      |                                    |
|          | (concentrations =)<br>$\frac{0.35}{0.01} \quad \frac{0.37}{0.01} \quad \frac{0.33}{0.01} \quad \frac{0.34}{0.01} (1)$ | allow correct use of incorrect / no conversion of volume                             |      |                                    |
|          | = 35      37      33      34 (1)                                                                                      |                                                                                      |      |                                    |
|          | (mean concentration =)<br>$\frac{35 + 37 + 33 + 34}{4} (1)$                                                           | (allow mean concentration =)<br>$\frac{139}{4}$                                      |      |                                    |
|          |                                                                                                                       | allow correct use of incorrectly determined concentrations                           |      |                                    |
|          | = 34.75 (g/dm <sup>3</sup> ) (1)                                                                                      | allow 34.75 (g/dm <sup>3</sup> ) correctly rounded to at least 2 significant figures |      |                                    |

|  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                  |  |  |
|--|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|--|
|  | <p><b>alternative approach 2 using total mass and total volume</b></p> <p>(total mass =<br/> <math>0.35 + 0.37 + 0.33 + 0.34 =</math><br/> <math>1.39 \text{ (g) (1)}</math></p> <p>(total volume =<br/> <math>10 + 10 + 10 + 10 =</math><br/> <math>40 \text{ cm}^3 \text{ (1)}</math></p> <p>(conversion <math>40 \text{ cm}^3 =</math><br/> <math>0.04 \text{ dm}^3 \text{ (1)}</math></p> <p>(mean concentration =) <math>\frac{1.39}{0.04} \text{ (1)}</math></p> <p><math>= 34.75 \text{ (g/dm}^3 \text{) (1)}</math></p> | <p>allow correct use of incorrectly determined total mass</p> <p>allow correct use of incorrect / no conversion of total volume</p> <p>allow <math>34.75 \text{ (g/dm}^3 \text{)}</math> correctly rounded to at least 2 significant figures</p> |  |  |
|--|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|--|

| Question    | Answers                                      | Extra information | Mark | AO / Spec. Ref. |
|-------------|----------------------------------------------|-------------------|------|-----------------|
| <b>01.6</b> | the samples were taken from different places |                   | 1    | AO3<br>4.10.1.2 |

|                         |           |
|-------------------------|-----------|
| <b>Total Question 1</b> | <b>11</b> |
|-------------------------|-----------|

## Question 2

| Question | Answers                 | Extra information | Mark | AO / Spec. Ref.           |
|----------|-------------------------|-------------------|------|---------------------------|
| 02.1     | fractional distillation |                   | 1    | AO1<br>4.1.1.2<br>4.7.1.2 |

| Question | Answers                  | Extra information                    | Mark | AO / Spec. Ref.           |
|----------|--------------------------|--------------------------------------|------|---------------------------|
| 02.2     | (heater)<br>evaporation  | allow liquid to gas<br>allow boiling | 1    | AO1<br>4.2.2.1<br>4.7.1.2 |
|          | (column)<br>condensation | allow gas to liquid                  | 1    |                           |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|----------|---------|-------------------|------|-----------------|
| 02.3     | petrol  |                   | 1    | AO3<br>4.7.1.2  |

| Question | Answers                                | Mark | AO / Spec. Ref. |
|----------|----------------------------------------|------|-----------------|
| 02.4     | heavy fuel oil → diesel oil → kerosene | 1    | AO3<br>4.7.1.2  |

| Question | Answers                        | Extra information | Mark | AO / Spec. Ref.           |
|----------|--------------------------------|-------------------|------|---------------------------|
| 02.5     | C <sub>4</sub> H <sub>10</sub> |                   | 1    | AO2<br>4.2.1.4<br>4.7.1.1 |

| Question | Answers         | Extra information | Mark | AO / Spec. Ref. |
|----------|-----------------|-------------------|------|-----------------|
| 02.6     | but <u>a</u> ne |                   | 1    | AO1<br>4.7.1.1  |

| Question | Answers                                                                                | Extra information                                                           | Mark | AO / Spec. Ref.                      |
|----------|----------------------------------------------------------------------------------------|-----------------------------------------------------------------------------|------|--------------------------------------|
| 02.7     | $\text{C}_3\text{H}_8 + 5 \text{O}_2 \rightarrow 3 \text{CO}_2 + 4 \text{H}_2\text{O}$ | allow 1 mark for 3 $\text{CO}_2$<br>allow 1 mark for 4 $\text{H}_2\text{O}$ | 2    | AO2<br>4.1.1.1<br>4.3.1.1<br>4.7.1.3 |

|                  |   |
|------------------|---|
| Total Question 2 | 9 |
|------------------|---|

## Question 3

| Question | Answers                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Mark | AO / Spec. Ref.                                     |
|----------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|-----------------------------------------------------|
| 03.1     | <b>Level 3:</b> A judgement, strongly linked and logically supported by a sufficient range of correct reasons, is given.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 5–6  | AO3<br>4.10.1.1<br>4.10.1.2<br>4.10.2.2<br>4.10.3.1 |
|          | <b>Level 2:</b> Some logically linked reasons are given. There may also be a simple judgement.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | 3–4  |                                                     |
|          | <b>Level 1:</b> Relevant points are made. They are not logically linked.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 1–2  |                                                     |
|          | <b>No relevant content</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 0    |                                                     |
|          | <b>Indicative content</b> <ul style="list-style-type: none"> <li>aluminium ore is a finite resource</li> <li>wood is a renewable resource</li> <li>aluminium ore has to be mined / quarried <ul style="list-style-type: none"> <li>which causes dust / noise pollution</li> </ul> </li> <li>trees require land for growing <ul style="list-style-type: none"> <li>which reduces land for farming</li> <li>which can lead to deforestation</li> </ul> </li> <li>cost of wood is lower <ul style="list-style-type: none"> <li>so more doors can be obtained for the same cost</li> </ul> </li> <li>aluminium is stronger <ul style="list-style-type: none"> <li>so less easily damaged</li> </ul> </li> <li>aluminium doors do not need painting <ul style="list-style-type: none"> <li>so less maintenance required</li> </ul> </li> <li>both are recyclable <ul style="list-style-type: none"> <li>so resources are conserved</li> <li>so less goes into landfill</li> <li>so less fossil fuels used</li> <li>so less climate change</li> </ul> </li> <li>judgement</li> </ul> |      |                                                     |

| Question    | Answers                                                             | Extra information                                                                         | Mark | AO / Spec. Ref. |
|-------------|---------------------------------------------------------------------|-------------------------------------------------------------------------------------------|------|-----------------|
| <b>03.2</b> | (the oxide coating) acts as a barrier                               | do <b>not</b> accept sacrificial protection                                               | 1    | AO1<br>4.10.3.1 |
|             | (that) prevents air / oxygen / water reaching the aluminium / metal | do <b>not</b> accept references to rusting<br>do <b>not</b> accept sacrificial protection | 1    |                 |

| Question    | Answers                                            | Extra information | Mark | AO / Spec. Ref. |
|-------------|----------------------------------------------------|-------------------|------|-----------------|
| <b>03.3</b> | a fixed mass of pigment and a fixed mass of liquid |                   | 1    | AO1<br>4.8.1.2  |

|                         |          |
|-------------------------|----------|
| <b>Total Question 3</b> | <b>9</b> |
|-------------------------|----------|

**Question 4**

| Question    | Answers                                | Extra information | Mark | AO / Spec. Ref. |
|-------------|----------------------------------------|-------------------|------|-----------------|
| <b>04.1</b> | (the percentage of) nitrogen increased |                   | 1    | AO1<br>4.9.1.2  |
|             | (because of intense) volcanic activity |                   | 1    |                 |

| Question    | Answers                                      | Extra information                                   | Mark | AO / Spec. Ref. |
|-------------|----------------------------------------------|-----------------------------------------------------|------|-----------------|
| <b>04.2</b> | (carbon dioxide) dissolved in water / oceans |                                                     | 1    | AO1<br>4.9.1.2  |
|             | (carbonate) forming sediments / precipitates | do <b>not</b> accept formed shells of sea creatures | 1    |                 |
|             |                                              | do <b>not</b> accept photosynthesis                 |      |                 |
|             |                                              | do <b>not</b> accept formed fossil fuels            |      |                 |

| Question    | Answers                           | Extra information                                     | Mark | AO / Spec. Ref.           |
|-------------|-----------------------------------|-------------------------------------------------------|------|---------------------------|
| <b>04.3</b> | all four points plotted correctly | allow a tolerance of $\pm \frac{1}{2}$ a small square | 1    | AO2<br>4.9.1.2<br>4.9.1.4 |
|             | line of best fit                  |                                                       | 1    |                           |

| Question    | Answers                                                    | Extra information                                   | Mark | AO / Spec. Ref.           |
|-------------|------------------------------------------------------------|-----------------------------------------------------|------|---------------------------|
| <b>04.4</b> | carbon dioxide decreased<br><b>and</b><br>oxygen increased | ignore dissolving in oceans<br>ignore sedimentation | 1    | AO3                       |
|             | (because of) photosynthesis                                | do <b>not</b> accept respiration                    | 1    | AO1                       |
|             | (by) algae / plants                                        | allow (by) cyanobacteria                            | 1    | AO1<br>4.9.1.3<br>4.9.1.4 |

|                         |          |
|-------------------------|----------|
| <b>Total Question 4</b> | <b>9</b> |
|-------------------------|----------|

## Question 5

| Question | Answers  | Extra information                           | Mark | AO / Spec. Ref. |
|----------|----------|---------------------------------------------|------|-----------------|
| 05.1     | – 6 (°C) | allow a value in the range (+)4 to –16 (°C) | 1    | AO2<br>4.7.1.3  |

| Question | Answers | Extra information                      | Mark | AO / Spec. Ref. |
|----------|---------|----------------------------------------|------|-----------------|
| 05.2     | ethanol | allow C <sub>2</sub> H <sub>5</sub> OH | 1    | AO2<br>4.7.2.2  |

| Question | Answers                                                                | Extra information                                                  | Mark | AO / Spec. Ref. |
|----------|------------------------------------------------------------------------|--------------------------------------------------------------------|------|-----------------|
| 05.3     | (test)<br>damp litmus paper                                            |                                                                    | 1    | AO1<br>4.8.2.4  |
|          | (result)<br>litmus paper is bleached<br>or<br>litmus paper turns white | ignore litmus paper turns red<br><br>ignore litmus paper turns red | 1    |                 |

| Question | Answers                                                                                                                                                                                                                                                                           | Extra information | Mark | AO / Spec. Ref. |
|----------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|------|-----------------|
| 05.4     | $  \begin{array}{ccccccc}  & \text{Cl} & \text{Cl} & \text{H} & \text{H} & & \\  &   &   &   &   & & \\  \text{H} & - \text{C} & - \text{C} & - \text{C} & - \text{C} & - \text{H} & \\  &   &   &   &   & & \\  & \text{H} & \text{H} & \text{H} & \text{H} & &   \end{array}  $ |                   | 1    | AO2<br>4.7.2.2  |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|----------|---------|-------------------|------|-----------------|
| 05.5     | propene |                   | 1    | AO1<br>4.7.2.1  |

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| Question | Answers                            | Extra information          | Mark | AO / Spec. Ref. |
|----------|------------------------------------|----------------------------|------|-----------------|
| 05.6     | (because of) incomplete combustion | ignore insufficient oxygen | 1    | AO1<br>4.7.2.2  |

| Question                | Answers                                                         | Extra information                                                    | Mark      | AO / Spec. Ref.                               |
|-------------------------|-----------------------------------------------------------------|----------------------------------------------------------------------|-----------|-----------------------------------------------|
| <b>05.7</b>             | (conversion $24 \text{ dm}^3 =$ )<br>$24\,000 \text{ cm}^3$     | allow conversion of volume<br>anywhere in method                     | 1         | AO2<br>4.3.1.2<br>4.3.2.1<br>4.3.5<br>4.7.2.1 |
|                         | ( $M_r = (3 \times 12) + (6 \times 1) =$ )<br>42                |                                                                      | 1         |                                               |
|                         | (moles $= \frac{2.1}{42} =$ ) 0.05                              | allow correct use of an<br>incorrectly determined $M_r$              | 1         |                                               |
|                         | (volume $=$ ) $24\,000 \times 0.05$                             | allow correct use of an<br>incorrectly determined number<br>of moles | 1         |                                               |
|                         |                                                                 | allow correct use of an incorrect<br>/ no conversion of volume       |           |                                               |
|                         | $= 1200 \text{ (cm}^3\text{)}$                                  |                                                                      | 1         |                                               |
|                         | <b>alternative approach</b>                                     |                                                                      |           |                                               |
|                         | (conversion $24 \text{ dm}^3 =$ )<br>$24\,000 \text{ cm}^3$ (1) | allow conversion of volume<br>anywhere in method                     |           |                                               |
|                         | ( $M_r = (3 \times 12) + (6 \times 1) =$ )<br>42 (1)            |                                                                      |           |                                               |
|                         | (ratio of mass $= \frac{42}{2.1} =$ ) 20 (1)                    | allow correct use of an<br>incorrectly determined $M_r$              |           |                                               |
|                         | (volume $=$ ) $\frac{24\,000}{20}$ (1)                          | allow correct use of an incorrect<br>/ no conversion of volume       |           |                                               |
|                         | $= 1200 \text{ (cm}^3\text{)} (1)$                              |                                                                      |           |                                               |
| <b>Total Question 5</b> |                                                                 |                                                                      | <b>12</b> |                                               |

**Question 6**

| Question    | Answers                                         | Extra information                                                                                           | Mark | AO / Spec. Ref.        |
|-------------|-------------------------------------------------|-------------------------------------------------------------------------------------------------------------|------|------------------------|
| <b>06.1</b> | calcium (ions)<br><b>or</b><br>magnesium (ions) | allow $\text{Ca}^{2+}$ (ion)<br><br>allow $\text{Mg}^{2+}$ (ion)<br><br>allow zinc / $\text{Zn}^{2+}$ (ion) | 1    | AO1<br>4.8.3.2<br>RPA7 |

| Question    | Answers                                                             | Extra information                                             | Mark | AO / Spec. Ref.        |
|-------------|---------------------------------------------------------------------|---------------------------------------------------------------|------|------------------------|
| <b>06.2</b> | (test)<br>add excess sodium hydroxide (solution)                    |                                                               | 1    | AO1<br>4.8.3.2<br>RPA7 |
|             | (result)<br>with sodium hydroxide the (white) precipitate dissolves | allow with sodium hydroxide a colourless solution is produced | 1    |                        |

| Question    | Answers          | Extra information | Mark | AO / Spec. Ref.                   |
|-------------|------------------|-------------------|------|-----------------------------------|
| <b>06.3</b> | $\text{Ca}^{2+}$ | ignore calcium    | 1    | AO1<br>4.2.1.2<br>4.8.3.1<br>RPA7 |

| Question    | Answers       | Extra information | Mark | AO / Spec. Ref.                   |
|-------------|---------------|-------------------|------|-----------------------------------|
| <b>06.4</b> | $\text{Cl}^-$ | ignore chloride   | 1    | AO1<br>4.2.1.2<br>4.8.3.4<br>RPA7 |

| Question | Answers                                         | Extra information                                            | Mark | AO / Spec. Ref.                   |
|----------|-------------------------------------------------|--------------------------------------------------------------|------|-----------------------------------|
| 06.5     | (test)<br>(bubble the gas through)<br>limewater | allow (bubble the gas through)<br>calcium hydroxide solution | 1    | AO1<br>4.8.2.3<br>4.8.3.3<br>RPA7 |
|          | (result)<br>(which) turns milky / cloudy        |                                                              | 1    |                                   |
|          |                                                 | MP2 is dependent upon MP1<br>being awarded                   |      |                                   |

| Question | Answers                                                | Extra information                                       | Mark | AO / Spec. Ref. |
|----------|--------------------------------------------------------|---------------------------------------------------------|------|-----------------|
| 06.6     |                                                        | allow converse argument                                 |      |                 |
|          | (using ethanoic acid)<br>the rate of reaction is lower |                                                         | 1    |                 |
|          | (because) ethanoic acid is a<br>weak(er) acid          |                                                         | 1    |                 |
|          | (so) the concentration of<br>hydrogen ions is lower    | allow (so) ethanoic acid is (only)<br>partially ionised | 1    |                 |
|          | (and) the frequency of collisions<br>is lower          |                                                         | 1    |                 |

|                         |           |
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| <b>Total Question 6</b> | <b>11</b> |
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## Question 7

| Question | Answers                 | Extra information | Mark | AO / Spec. Ref. |
|----------|-------------------------|-------------------|------|-----------------|
| 07.1     | (A)<br>ethanediol       |                   | 1    | AO1<br>4.7.3.2  |
|          | (B)<br>hexanedioic acid |                   | 1    |                 |

| Question | Answers   | Extra information | Mark | AO / Spec. Ref. |
|----------|-----------|-------------------|------|-----------------|
| 07.2     | polyester |                   | 1    | AO1<br>4.7.3.2  |

| Question | Answers | Extra information      | Mark | AO / Spec. Ref. |
|----------|---------|------------------------|------|-----------------|
| 07.3     | water   | allow H <sub>2</sub> O | 1    | AO1<br>4.7.3.2  |

| Question | Answers     | Extra information                 | Mark | AO / Spec. Ref. |
|----------|-------------|-----------------------------------|------|-----------------|
| 07.4     | polypeptide | allow polyamide<br>ignore protein | 1    | AO1<br>4.7.3.3  |

| Question | Answers                                                                                                                                                                                                     | Extra information | Mark | AO / Spec. Ref.           |
|----------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|------|---------------------------|
| 07.5     | $  \begin{array}{ccccc}  \text{H} & \text{H} & & & \\    &   & & & \\  \text{N} & - \text{C} & - & \text{C} = \text{O} \\    &   & &   & \\  \text{H} & \text{H} & & \text{O} - \text{H} &   \end{array}  $ |                   | 1    | AO2<br>4.7.2.4<br>4.7.3.3 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|----------|---------|-------------------|------|-----------------|
| 07.6     | protein |                   | 1    | AO1<br>4.7.3.3  |

| Question    | Answers                                     | Extra information                                                                                                                                                                                                                                                                                                                                         | Mark | AO / Spec. Ref. |
|-------------|---------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|-----------------|
| <b>07.7</b> | 4 × C-F <b>and</b> 1 × C-C bonds            |                                                                                                                                                                                                                                                                                                                                                           | 1    | AO2<br>4.7.3.1  |
|             | 2 × single bonds extending through brackets |                                                                                                                                                                                                                                                                                                                                                           | 1    |                 |
|             | n after polymer repeating unit              | <p>an answer of</p> $n \begin{array}{c} \text{F} \quad \text{F} \\   \quad   \\ \text{C} = \text{C} \\   \quad   \\ \text{F} \quad \text{F} \end{array} \longrightarrow \left( \begin{array}{c} \text{F} \quad \text{F} \\   \quad   \\ -\text{C} - \text{C}- \\   \quad   \\ \text{F} \quad \text{F} \end{array} \right)_n$ <p>scores <b>3</b> marks</p> | 1    |                 |

| Question    | Answers                                | Extra information                         | Mark | AO / Spec. Ref. |
|-------------|----------------------------------------|-------------------------------------------|------|-----------------|
| <b>07.8</b> | long chain molecules                   | allow long chains of monomers             | 1    | AO1<br>4.10.3.3 |
|             | with covalent bonds between the chains | allow with cross links between the chains | 1    |                 |
|             |                                        | ignore intermolecular forces              |      |                 |

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| <b>Total Question 7</b> | <b>12</b> |
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## Question 8

| Question | Answers                              | Extra information    | Mark | AO / Spec. Ref.           |
|----------|--------------------------------------|----------------------|------|---------------------------|
| 08.1     | a gas was produced                   | allow oxygen for gas | 1    | AO2<br>4.3.1.3<br>4.6.1.4 |
|          | (and the gas) escaped from the flask |                      | 1    |                           |

| Question | Answers                                                | Extra information                                                                                                              | Mark | AO / Spec. Ref.           |
|----------|--------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------|------|---------------------------|
| 08.2     | catalysts provide a different pathway for the reaction |                                                                                                                                | 1    | AO3<br>4.6.1.3<br>4.6.1.4 |
|          | (and) the activation energy using <b>B</b> is lower    | allow converse                                                                                                                 | 1    |                           |
|          | (so) the rate of reaction is higher using <b>B</b>     | allow converse<br><br>allow (so) the reaction using <b>B</b> has more particles with an energy exceeding the activation energy | 1    |                           |

| Question    | Answers                                                            | Extra information                                                                                                          | Mark | AO / Spec. Ref. |
|-------------|--------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------|------|-----------------|
| <b>08.3</b> | tangent at 60 s                                                    |                                                                                                                            | 1    | AO2<br>4.6.1.1  |
|             | value for x step <b>and</b> y step from tangent                    | allow a tolerance of $\pm \frac{1}{2}$ a small square<br><br>allow correct use of an incorrect tangent                     | 1    |                 |
|             | (rate =) $\frac{\text{value for y step}}{\text{value for x step}}$ | allow correct use of incorrectly determined x and / or y step from a drawn tangent                                         | 1    |                 |
|             | correct calculation of rate                                        |                                                                                                                            | 1    |                 |
|             | answer in standard form                                            | allow an answer correctly given in standard form from an incorrect calculation which uses values determined from the graph | 1    |                 |

| Question    | Answers                                                                 | Extra information                                                                               | Mark | AO / Spec. Ref.           |
|-------------|-------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------|------|---------------------------|
| <b>08.4</b> |                                                                         | allow converse                                                                                  | 1    | AO1<br>4.6.1.2<br>4.6.1.3 |
|             | the rate (of decomposition / reaction) increases at higher temperatures |                                                                                                 |      |                           |
|             | (because) particles have more energy                                    | allow (because) particles move faster                                                           |      |                           |
|             | (so) collide more frequently                                            | allow (and) a greater proportion collide with sufficient energy to exceed the activation energy | 1    |                           |

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| <b>Total Question 8</b> | <b>13</b> |
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## Question 9

| Question | Answers                                                              | Extra information                                             | Mark | AO / Spec. Ref.                      |
|----------|----------------------------------------------------------------------|---------------------------------------------------------------|------|--------------------------------------|
| 09.1     | the forward reaction is endothermic                                  |                                                               | 1    | AO2<br>4.6.1.3<br>4.6.2.4<br>4.6.2.6 |
|          | (so high temperature) shifts the equilibrium (position) to the right |                                                               | 1    |                                      |
|          | (which) increases the yield (of products)                            | allow (and a high temperature) increases the rate of reaction | 1    |                                      |

| Question | Answers                                                       | Extra information                                     | Mark | AO / Spec. Ref.           |
|----------|---------------------------------------------------------------|-------------------------------------------------------|------|---------------------------|
| 09.2     | (low pressure) shifts the equilibrium (position) to the right | allow converse                                        | 1    | AO2<br>4.6.2.4<br>4.6.2.7 |
|          | (because) there are more moles on the right                   | allow (because) there are more molecules on the right | 1    |                           |

| Question | Answers                           | Extra information | Mark | AO / Spec. Ref.           |
|----------|-----------------------------------|-------------------|------|---------------------------|
| 09.3     | no effect on equilibrium position |                   | 1    | AO3<br>4.6.1.4<br>4.6.2.3 |

| Question | Answers                                         | Extra information                                                  | Mark | AO / Spec. Ref.            |
|----------|-------------------------------------------------|--------------------------------------------------------------------|------|----------------------------|
| 09.4     | $(\text{volume} \sim) \frac{50 \times 100}{80}$ | allow a value in the range 78.0 to 80.0 for percentage of nitrogen | 1    | AO2<br>4.9.1.1<br>4.10.4.1 |
|          | $\sim 62.5 \text{ (dm}^3\text{)}$               |                                                                    | 1    |                            |

| Question    | Answers                                      | Extra information | Mark | AO / Spec. Ref. |
|-------------|----------------------------------------------|-------------------|------|-----------------|
| <b>09.5</b> | (the reaction mixture is) cooled             |                   | 1    | AO1<br>4.10.4.1 |
|             | (so that) ammonia condenses / liquefies      |                   | 1    |                 |
|             | (but) nitrogen <b>and</b> hydrogen are gases |                   | 1    |                 |

| Question    | Answers                                                                                                                                                                                                                                                                                                                                                                  | Extra information                                                                                                                     | Mark | AO / Spec. Ref.             |
|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------|------|-----------------------------|
| <b>09.6</b> | any <b>three</b> from:                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                       | 3    | AO3<br>4.10.1.1<br>4.10.4.1 |
|             | <ul style="list-style-type: none"> <li>nitrogen is an abundant gas (in the air)</li> <li>the use of nitrogen releases fewer greenhouse gases</li> <li>the nitrogen released replaces that used to make ammonia</li> <li>natural gas is a finite resource</li> <li>(the use of hydrogen / methane releases) carbon dioxide which contributes to climate change</li> </ul> | <p>allow nitrogen is renewable</p> <p>allow (the use of hydrogen / methane releases) carbon dioxide contributes to global warming</p> |      |                             |

|                         |           |
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| <b>Total Question 9</b> | <b>14</b> |
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