

**GCSE (9-1)**

**Chemistry A (Gateway)**

Unit **J248H/04**: Higher Tier – Paper 4

General Certificate of Secondary Education

**Mark Scheme for June 2018**

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This mark scheme is published as an aid to teachers and students, to indicate the requirements of the examination. It shows the basis on which marks were awarded by examiners. It does not indicate the details of the discussions which took place at an examiners' meeting before marking commenced.

All examiners are instructed that alternative correct answers and unexpected approaches in candidates' scripts must be given marks that fairly reflect the relevant knowledge and skills demonstrated.

Mark schemes should be read in conjunction with the published question papers and the report on the examination.

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Annotations available in RM Assessor

| Annotation  | Meaning                                |
|---|--|
|    | Correct response                       |
|    | Incorrect response                     |
|    | Omission mark                          |
|    | Benefit of doubt given                 |
|    | Contradiction                          |
|    | Rounding error                         |
|    | Error in number of significant figures |
|    | Error carried forward                  |
|    | Level 1                                |
|    | Level 2                                |
|   | Level 3                                |
|  | Benefit of doubt not given             |
|  | Noted but no credit given              |
|  | Ignore                                 |

Abbreviations, annotations and conventions used in the detailed Mark Scheme (to include abbreviations and subject-specific conventions).

| <b>Annotation</b>   | <b>Meaning</b>  |
|---------------------|---|
| /                   | alternative and acceptable answers for the same marking point |
| ✓                   | Separates marking points                                      |
| <b>DO NOT ALLOW</b> | Answers which are not worthy of credit                        |
| <b>IGNORE</b>       | Statements which are irrelevant                               |
| <b>ALLOW</b>        | Answers that can be accepted                                  |
| ( )                 | Words which are not essential to gain credit                  |
| —                   | Underlined words must be present in answer to score a mark    |
| <b>ECF</b>          | Error carried forward   |
| <b>AW</b>           | Alternative wording   |
| <b>ORA</b>          | Or reverse argument   |

**Subject-specific Marking Instructions****INTRODUCTION**

Your first task as an Examiner is to become thoroughly familiar with the material on which the examination depends. This material includes:

- the specification, especially the assessment objectives
- the question paper
- the mark scheme.

You should ensure that you have copies of these materials.

You should ensure also that you are familiar with the administrative procedures related to the marking process. These are set out in the OCR booklet **Instructions for Examiners**. If you are examining for the first time, please read carefully **Appendix 5 Introduction to Script Marking: Notes for New Examiners**.

Please ask for help or guidance whenever you need it. Your first point of contact is your Team Leader.

The breakdown of Assessment Objectives for GCSE (9-1) in Chemistry:

|              | <b>Assessment Objective</b>   |
|--------------|---|
| <b>AO1</b>   | <b>Demonstrate knowledge and understanding of scientific ideas and scientific techniques and procedures.</b>  |
| AO1.1        | Demonstrate knowledge and understanding of scientific ideas.  |
| AO1.2        | Demonstrate knowledge and understanding of scientific techniques and procedures.  |
| <b>AO2</b>   | <b>Apply knowledge and understanding of scientific ideas and scientific enquiry, techniques and procedures.</b>                                       |
| AO2.1        | Apply knowledge and understanding of scientific ideas.  |
| AO2.2        | Apply knowledge and understanding of scientific enquiry, techniques and procedures.   |
| <b>AO3</b>   | <b>Analyse information and ideas to interpret and evaluate, make judgements and draw conclusions and develop and improve experimental procedures.</b> |
| <b>AO3.1</b> | Analyse information and ideas to interpret and evaluate.  |
| AO3.1a       | Analyse information and ideas to interpret.   |
| AO3.1b       | Analyse information and ideas to evaluate.  |
| <b>AO3.2</b> | Analyse information and ideas to make judgements and draw conclusions.  |
| AO3.2a       | Analyse information and ideas to make judgements.   |
| AO3.2b       | Analyse information and ideas to draw conclusions.  |
| <b>AO3.3</b> | Analyse information and ideas to develop and improve experimental procedures.   |
| AO3.3a       | Analyse information and ideas to develop experimental procedures.   |
| AO3.3b       | Analyse information and ideas to improve experimental procedures.   |

| Question |  |  | Answer | Marks | AO element | Guidance |
|----------|--|--|--------|-------|------------|----------|
| 1        |  |  | D ✓    | 1     | 2.1        |          |
| 2        |  |  | C ✓    | 1     | 1.2        |          |
| 3        |  |  | C ✓    | 1     | 1.1        |          |
| 4        |  |  | D ✓    | 1     | 2.2        |          |
| 5        |  |  | D ✓    | 1     | 1.1        |          |
| 6        |  |  | C ✓    | 1     | 2.1        |          |
| 7        |  |  | A ✓    | 1     | 2.2        |          |
| 8        |  |  | D ✓    | 1     | 1.2        |          |
| 9        |  |  | C ✓    | 1     | 1.1        |          |
| 10       |  |  | C ✓    | 1     | 1.2        |          |
| 11       |  |  | C ✓    | 1     | 2.2        |          |
| 12       |  |  | A ✓    | 1     | 1.1        |          |
| 13       |  |  | B ✓    | 1     | 1.1        |          |
| 14       |  |  | B ✓    | 1     | 1.1        |          |
| 15       |  |  | A ✓    | 1     | 1.2        |          |

For answers to Section A if an answer box is blank ALLOW correct indication of answer e.g. circled or underlined.

| Question |     | Answer   | Marks | AO element | Guidance  |
|----------|-----|--|-------|------------|---|
| 16       | (a) | <p>(Electric car) uses<br/>Less energy (needed to make it) ✓</p> <p>Causes less global warming / less greenhouse gases produced ✓</p> <p>Causes less ozone ✓</p> | 3     | 3 x 3.1b   | <p><b>IGNORE</b> just a restatement of the data; must be a comparison</p> <p><b>IGNORE</b> references to carbon footprint<br/><b>DO NOT ALLOW</b> eg less greenhouses gases so less acid rain</p> <p><b>ALLOW</b> less water pollution <b>than</b> (making) <b>a diesel car</b> / produces the second least water pollution</p> <p><b>IGNORE</b> less (water) pollution</p> |



| Question | Answer   | Marks | AO element | Guidance  |
|----------|--|-------|------------|---|
| (b)      | <p><b>MAX TWO FROM:</b><br/>           Idea that (fractionating) column has a temperature gradient ✓</p> <p>Idea that crude oil contains a range of molecular sizes ✓</p> <p>Idea that molecules or fractions or hydrocarbons or alkanes have different boiling points ✓</p> <p>Idea that molecules or fractions or hydrocarbons or alkanes condense at different levels (in the fractionating column) ✓</p> <p><b>PLUS</b><br/> <b>AT LEAST ONE FROM:</b><br/>           Larger molecules have higher boiling points / ORA ✓</p> <p>Intermolecular forces between larger molecules are strong(er) / ORA / larger molecules have more intermolecular forces / ORA ✓</p> <p>The stronger the intermolecular forces the higher the boiling point or more energy is required to break these forces / ORA ✓</p> <p>During boiling intermolecular forces are broken ✓</p> | 3     | 3 x 1.1    | <p><b>DO NOT ALLOW</b> just idea that molecules or fractions have different <b>melting</b> points</p> <p><b>NB This marking point gains TWO MARKS as it also includes M3 above</b><br/> <b>ALLOW</b> longer chains molecules for larger molecules<br/> <b>ALLOW</b> bitumen or fuel oil as a named large molecule /<br/>           LPG or petrol as a named small molecule</p> <p><b>ALLOW</b> bonds between molecules for forces between molecules</p> <p><b>ALLOW</b> heat for energy</p> <p><b>BUT</b> the larger the molecule the stronger the intermolecular forces therefore the higher the boiling point <b>scores 3 / ORA</b></p> |

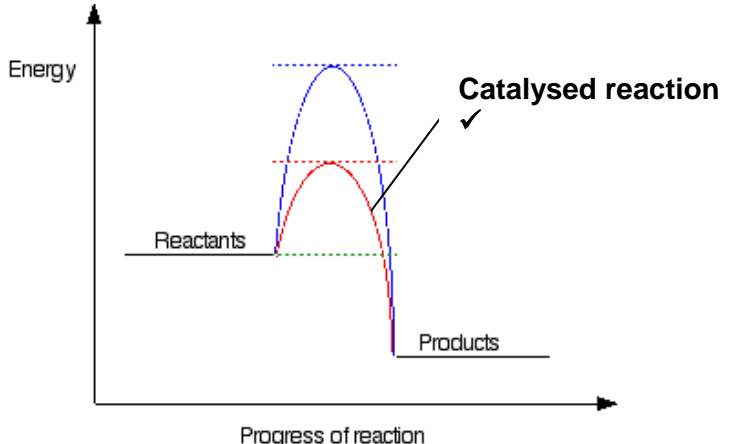
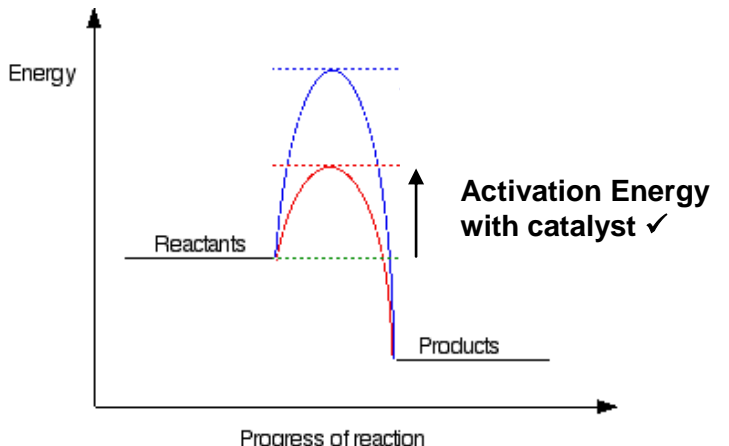
| Question |     | Answer  | Marks    | AO element             | Guidance   |
|----------|-----|---|----------|------------------------|--|
|          | (c) | <p><b>A</b> ✓</p> <p>Idea that (LPG fraction) has the lowest boiling point ✓</p>  | <b>2</b> | <p>3.2b</p> <p>1.1</p> | <p><b>Second mark is dependent on correct choice of A</b><br/> <b>ALLOW</b> -2(°C)</p> <p><b>ALLOW</b> A / LPG is a gas at room temperature<br/> <b>ALLOW</b> idea that LPG is collected at the top of the tower so must have the lowest (boiling) temperature<br/> <b>IGNORE</b> just quoting data from the table</p>   |
|          | (d) | <p><b>ANY TWO Advantages of fuel cell:</b></p> <p>Refuelling time (for a fuel cell) is less / ORA ✓</p> <p>Fuel cell emits less CO<sub>2</sub> / ORA ✓</p> <p>Mass (of car) is less (with fuel cell) / ORA ✓</p> <p><b>AND</b><br/> <b>Disadvantage of fuel cell:</b><br/> Cost of refuelling is more / ORA ✓</p> | <b>3</b> | 3 x 3.1b               | <p><b>Assume unqualified answer refers to fuel cell</b><br/> <b>IGNORE</b> just a restatement of the data; must be a <b>comparison</b></p> <p><b>ALLOW</b> fuel cell takes 356 minutes less to refuel / ORA<br/> <b>ALLOW</b> fuel cell <b>only</b> takes 4 minutes to refuel</p> <p><b>ALLOW</b> fuel cell emits 12kg less CO<sub>2</sub> / ORA<br/> <b>ALLOW</b> fuel cell <b>only</b> emits 36 kg CO<sub>2</sub></p> <p><b>ALLOW</b> mass of car with fuel cell is 350(kg) less than electric car / ORA<br/> <b>ALLOW</b> mass of car with fuel cell is <b>only</b> 1200(kg)<br/> <b>IGNORE</b> electric car is faster</p> <p><b>ALLOW</b> cost of refuelling car with fuel cell is £1 more than an electric car / ORA<br/> <b>ALLOW</b> cost of refuelling electric car is <b>only</b> £3.20<br/> <b>ALLOW</b> costs more to run</p> |



| Question |     | Answer                 | Marks | AO element | Guidance   |
|----------|-----|------------------------|-------|------------|--|
|          | (d) | CH <sub>3</sub> COOH ✓ | 1     | 2.2        | <b>ALLOW</b> C <sub>2</sub> H <sub>4</sub> O <sub>2</sub><br><b>ALLOW</b> displayed formula, ie<br>$\begin{array}{c} \text{H} \\   \\ \text{H}-\text{C}-\text{C} \\   \quad \diagup \\ \text{H} \quad \text{O} \\ \quad \quad   \\ \quad \quad \text{O}-\text{H} \end{array}$<br><b>DO NOT ALLOW</b> CH <sup>3</sup> COOH / CH <sub>3</sub> COOH |

| Question |     | Answer  | Marks   | AO element | Guidance   |  |
|----------|-----|---|---|------------|--|--|
| 18       | (a) | $\text{CaCO}_3 + 2\text{HCl} \rightarrow \text{CaCl}_2 + \text{CO}_2 + \text{H}_2\text{O}$<br><br>Formulae ✓<br>Balancing ✓ | 2   | 2 x 2.2    | <b>ALLOW</b> any correct multiple, including fractions<br><b>ALLOW</b> = / ⇒ instead of →<br><b>DO NOT ALLOW</b> and / & instead of '+'<br>balancing mark is dependent on the correct formulae but<br><b>ALLOW</b> 1 mark for a balanced equation with a minor error in subscripts / formulae<br>e.g $\text{CaCO}_3 + 2\text{HCl} \rightarrow \text{CaCl}_2 + \text{CO}_2 + \text{H}_2\text{O}$<br><br><b>IGNORE</b> state symbols |  |
|          | (b) | (i)   | 0 – 30 seconds ✓  | 1          | 3.1a   | <b>ALLOW</b> correct answer ticked, circled or underlined in list if answer line is blank  |
|          |     | (ii)  | <b>FIRST CHECK THE ANSWER ON ANSWER LINE</b><br><b>If answer = 0.44 award 3 marks</b><br><br>(Rate = ) $20 \div 45$ ✓<br><br>$= 0.4444\dots$ ✓<br><br>2 sig figs = 0.44 ✓ | 3          | 1.2<br>2 x 2.2   | <b>ALLOW</b> volume of 19 or 19.5<br><br><b>ALLOW</b> 0.4222.... (vol=19) or 0.4333.... (vol=19.5)<br><b>ALLOW</b> ECF from incorrect <b>volume</b><br><br><b>ALLOW</b> 0.42.... (vol=19) or 0.43.... (vol=19.5)<br><b>ALLOW</b> ECF from calculation<br><b>IGNORE</b> answer with recurring dot |

| Question |     | Answer  | Marks    | AO element | Guidance  |
|----------|-----|---|----------|------------|---|
|          | (c) | <p><b>ANY FOUR FROM:</b></p> <p><b>More dilute acid:</b></p> <ul style="list-style-type: none"> <li>idea of less <b>crowded</b> acid particles / less acid particles <b>in same volume</b> ✓</li> <li>idea of reduced collision <b>frequency</b> (between acid and calcium carbonate) ✓</li> </ul> <p><b>Decreasing the temperature of the acid:</b></p> <ul style="list-style-type: none"> <li>idea that acid particles move slower / particles have less energy ✓</li> <li>idea of reduced collision <b>frequency</b> (between acid and calcium carbonate) ✓</li> <li>idea of less successful collisions / collisions between marble chips and acid are less energetic ✓</li> </ul> | <b>4</b> | 4 x 2.2    | <p><b>ALLOW</b> molecules or ions but <b>DO NOT ALLOW</b> atoms</p> <p><b>IGNORE</b> references to just 'less (acid) particles'</p> <p><b>ALLOW</b> particles collide less <b>often</b><br/> <b>IGNORE</b> references to 'faster' collisions<br/> <b>IGNORE</b> references to successful collisions</p> <p><b>ALLOW</b> particles collide less <b>often</b><br/> <b>IGNORE</b> references to 'faster' collisions</p> <p><b>ALLOW</b> eg less successful collisions per second for 2 marks</p> |

| Question |      | Answer  | Marks | AO element | Guidance  |
|----------|------|---|-------|------------|---|
| (d)      | (i)  |  <p>Energy</p> <p>Reactants</p> <p>Products</p> <p>Progress of reaction</p> <p>Catalysed reaction ✓</p>               | 1     | 1.1        | ALLOW unlabelled reaction profile   |
|          | (ii) |  <p>Energy</p> <p>Reactants</p> <p>Products</p> <p>Progress of reaction</p> <p>Activation Energy with catalyst ✓</p> | 1     | 1.1        | ALLOW ECF from incorrect reaction profile<br>DO NOT ALLOW double headed arrow or line without arrow |

| Question | Answer   | Marks | AO element                      | Guidance  |
|----------|--|-------|---------------------------------|---|
| 19*      | <p>Please refer to the marking instructions on page 4 of this mark scheme for guidance on how to mark this question.</p> <p><b>Level 3 (5–6 marks)</b><br/> <b>Analyses the information about the reaction and applies knowledge and understanding of chemical equilibria to fully explain why the conditions used for the process are chosen.</b><br/> <i>There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.</i></p> <p><b>Level 2 (3–4 marks)</b><br/> <b>Analyses the information about the reaction and applies knowledge and understanding of chemical equilibria to attempt to explain why the conditions used for the process are chosen.</b><br/> <i>There is a line of reasoning presented with some structure. The information presented is relevant and supported by some evidence.</i></p> <p><b>Level 1 (1–2 marks)</b><br/> <b>Applies knowledge and understanding to describe factors that affect rate of reaction or position of equilibrium.</b><br/> <i>There is an attempt at a logical structure with a line of reasoning. The information is in the most part relevant.</i></p> <p><b>0 marks</b><br/> <i>No response or no response worthy of credit.</i></p> | 6     | 2 x 3.2b<br>2 x 3.1a<br>2 x 2.2 | <p><b>AO3.2b Analyses information to draw conclusions about the conditions used for the process</b></p> <ul style="list-style-type: none"> <li>• (Increasing temperature moves equilibrium to left because) forward reaction is exothermic</li> <li>• (Increasing pressure moves equilibrium to right because) 1 (gaseous) mole on RHS and 2 (gaseous) moles on LHS / fewer (gaseous) moles on RHS</li> <li>• (By removing ethanol from the equilibrium mixture position of equilibrium shifts to right because) system shifts to replace ethanol</li> </ul> <p><b>AO3.1a Analyses information to interpret the conditions used for the process</b></p> <ul style="list-style-type: none"> <li>• Increasing temperature shifts position of equilibrium to left / increasing temperature decreases (percentage) yield / increasing temperature favours backward reaction / ORA</li> <li>• Increasing pressure shifts position of equilibrium to right / increasing pressure increases (percentage) yield / increasing pressure favours forward reaction / ORA</li> <li>• (By removing ethanol from the equilibrium mixture) position of equilibrium shifts to right / forward reaction is favoured</li> </ul> <p><b>AO2.2 Applies knowledge and understanding of the conditions used for the process</b></p> <ul style="list-style-type: none"> <li>• Increasing temperature increases rate of reaction / temperature used to have a high rate of reaction</li> <li>• But higher temperatures are expensive (to generate and maintain)</li> <li>• Higher pressures increase rate of reaction</li> <li>• But higher pressures are expensive (to generate and maintain) so higher pressure not used</li> <li>• Catalyst increases rate of reaction</li> <li>• Catalyst does not change position of equilibrium / does not change (percentage) yield</li> </ul> |



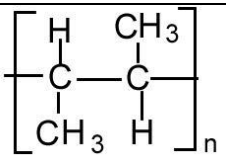
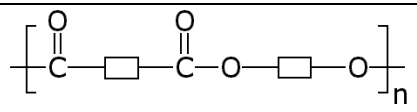
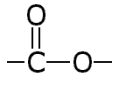
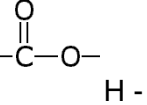
| Question |     | Answer   | Marks | AO element | Guidance   |
|----------|-----|--|-------|------------|--|
| 20       | (a) | <p><b>ANY FOUR FROM:</b><br/>           Do not add more sodium hydroxide after the indicator changes colour ✓<br/>           As indicator changes colour at endpoint /<br/>           idea that addition of more sodium hydroxide will make the solution alkaline ✓</p> <p>Add the sodium hydroxide dropwise or slowly (towards the endpoint) ✓<br/>           As indicator should change colour on addition of one drop (of alkali) ✓</p> <p>Idea of using a single indicator rather than a mixed indicator (such as universal indicator) ✓<br/>           As single indicator will give a sharp endpoint ✓</p> <p>Idea of swirling the conical flask during the addition of sodium hydroxide ✓<br/>           To ensure mixing of acid and alkali / AW ✓</p> <p>Idea of washing down the side of the conical flask with distilled water close to the endpoint ✓<br/>           Idea of ensuring all the alkali enters the reaction mixture ✓</p> <p>Use a white tile under the conical flask ✓<br/>           Idea of seeing the endpoint more clearly ✓</p> | 4     | 4 x 3.3b   | <p><b>All marking points are independent</b><br/> <b>IGNORE</b> repeat the titration<br/> <b>IGNORE</b> idea of using a pH probe or meter</p> <p><b>ALLOW</b> idea of obtaining an exact endpoint</p> <p><b>ALLOW</b> named single indicator eg methyl orange</p> <p><b>ALLOW</b> idea that method is incorrect, and they read the burette to find out how much <b>alkali</b> reacts with 25.0 cm<sup>3</sup> of sulfuric acid</p> |
|          | (b) | Idea that endpoint can be determined more accurately using a pH probe / datalogger ✓   | 1     | 3.3b       | <p><b>ALLOW</b> idea that a pH probe or datalogger doesn't rely on human judgement<br/> <b>ALLOW</b> idea that pH probe or datalogger gives a numerical value / specific pH<br/> <b>IGNORE</b> pH probe / datalogger is more reliable</p>  |

| Question |     | Answer | Marks  | AO element | Guidance |  |
|----------|-----|--------|--|------------|----------|--|
|          | (c) | (i)    | 1.4 ✓  | 1          | 2.2      |  |
|          |     | (ii)   | 30 (cm <sup>3</sup> ) ✓  | 1          | 2.2      |  |
|          | (d) | (i)    | <p>Titration 2 and 4 are consistent or concordant / only consistently close readings should be included / the volumes are close to one another / the volumes are within 0.2 cm<sup>3</sup> ✓</p> | 1          | 3.2b     | <p><b>ALLOW</b> volumes are similar</p> <p><b>ALLOW</b> titration 1 and 3 are inaccurate / idea that titration 1 and 3 show a wider range / idea that titration 1 is a rough titration and titration 3 is an outlier or is anomalous</p> |

| Question | Answer  | Marks | AO element | Guidance  |
|----------|---|-------|------------|---|
| (ii)     | <p><b>FIRST CHECK THE ANSWER ON ANSWER LINE</b><br/> <b>If answer = 0.25 award 4 marks</b></p> <p>average titre = <math>(25.1 + 25.0) \div 2 = 25.05 \text{ cm}^3 / 0.02505 \text{ dm}^3</math><br/> ✓</p> <p>no of moles in alkali = <math>\frac{0.200 \times 25.05}{1000} / 0.200 \times 0.02505 /</math><br/> <math>0.00501 / 5.01 \times 10^{-3}</math> ✓</p> <p>concentration of acid = <math>\frac{0.00501}{0.02} / \frac{0.00501 \times 1000}{20} /</math><br/> <math>\frac{5.01 \times 10^{-3}}{0.02} / \frac{5.01 \times 10^{-3} \times 1000}{20} /</math><br/> <math>0.2505 \text{ (mol/dm}^3\text{)} \checkmark</math></p> <p><b>2 Sig figs:</b><br/> concentration = <math>0.25 \text{ (mol/dm}^3\text{)} \checkmark</math></p> | 4     | 4 x 2.2    | <p><b>ALLOW</b> 0.005<br/> <b>ALLOW</b> ECF from average titre<br/> eg <math>25.1 \text{ cm}^3</math> gives moles of alkali = <math>0.00502 / 5.02 \times 10^{-3}</math></p> <p><b>ALLOW</b> ECF from moles of alkali<br/> i.e. conc = <math>\frac{\text{moles}}{0.02} / \frac{\text{moles} \times 1000}{20}</math><br/> <b>unit</b> not needed</p> |

| Question |     |      | Answer  | Marks | AO element        | Guidance  |
|----------|-----|------|---|-------|-------------------|---|
| 21       | (a) | (i)  | 0.25 (dm <sup>3</sup> ) ✓   | 1     | 2.2               |   |
|          |     | (ii) | 2.4 (g/dm <sup>3</sup> ) ✓  | 1     | 2.2               | <b>ALLOW</b> ECF from (a)(i), ie conc = 0.6 ÷ (a)(i)  |
|          | (b) | (i)  | <b>FIRST CHECK THE ANSWER ON ANSWER LINE</b><br><b>If answer = 0.05 award 2 marks</b><br><br>Moles of Zn = 3.27 ÷ 65.4 / 0.05 ✓<br><br>Idea that 1 mole of Zn forms 1 mole of H <sub>2</sub> , so<br>Moles of H <sub>2</sub> = 0.05 ✓   | 2     | 1.2<br>2.2        | <b>ALLOW</b> correct calculations using 65 for RAM of zinc rather than 65.4 i.e. 0.0503 moles of H <sub>2</sub><br><br><b>ALLOW</b> ECF from incorrectly calculated moles of Zn   |
|          |     | (ii) | <b>FIRST CHECK THE ANSWER ON ANSWER LINE</b><br><b>If answer = 1.2 award 2 marks</b><br><br>Volume = mol x 24 / 0.05 x 24 ✓<br><br>= 1.2 (dm <sup>3</sup> ) ✓   | 2     | 1.2<br>2.2        | <b>ALLOW</b> ECF from (b)(i), ie Vol = (b)(i) x 24<br><br><b>unit</b> not needed  |
|          | (c) | (i)  | <b>FIRST CHECK THE ANSWER ON ANSWER LINE</b><br><b>If answer = 17.6(%) award 3 marks</b><br><br>Atom economy = $\frac{6}{28 + 6} \times 100$ / $\frac{6}{34} \times 100$ ✓<br><br>= 17.647...(%)✓<br><br><b>3 sig figs = 17.6 (%)</b> ✓ | 3     | 2.2<br>2.2<br>1.2 | <b>ALLOW</b> atom economy formula in words for one mark<br>i.e. atom economy = $\frac{\text{total Mr of desired products}}{\text{total Mr of all products}} \times 100$<br><b>OR</b> atom economy = $\frac{\text{total Mr of desired products}}{\text{total Mr of all reactants}} \times 100$<br><br><b>ALLOW</b> ECF from incorrect RFMs<br><br><b>DO NOT ALLOW</b> 17.7 (%) for sig figs mark |

| Question |      | Answer  | Marks | AO element | Guidance   |
|----------|------|---|-------|------------|--|
|          | (ii) | <p><b>ANY THREE FROM:</b></p> <p>(%) yield ✓</p> <p>Usefulness of by-products ✓</p> <p>Rate of reaction ✓</p> <p>Equilibrium position (for reversible reactions) ✓</p> <p>Cost of raw materials / reactants ✓</p> <p>Energy requirement ✓</p> | 3     | 3 x 1.1    | <p><b>ALLOW</b> idea of cost of disposal of waste products</p> <p><b>IGNORE</b> ideas about harming the environment</p> <p><b>IGNORE</b> length of time for reaction</p> <p><b>ALLOW</b> cost of catalyst</p> <p><b>ALLOW</b> cost of (generating) high temperature / high pressure</p> <p><b>ALLOW</b> idea that use of a catalyst reduces temperature needed</p> <p><b>IGNORE</b> cost of equipment / plant / manufacturing costs / cheapest</p> <p><b>IGNORE</b> ideas about safety</p> |

| Question |         | Answer   | Marks | AO element | Guidance  |
|----------|---------|--|-------|------------|---|
| 22       | (a)     | (carbon to carbon) double bond / C=C ✓   | 1     | 1.1        | <b>ALLOW</b> (butene is) unsaturated  |
|          | (b)     | C <sub>n</sub> H <sub>2n</sub> ✓   | 1     | 1.1        | <b>ALLOW</b> H <sub>2n</sub> C <sub>n</sub><br><b>DO NOT ALLOW</b> C <sup>n</sup> H <sup>2n</sup> / C <sub>n</sub> H <sub>2n</sub>  |
|          | (c)     |  <p>Correct displayed formula ✓<br/>Use of brackets and 'n' ✓</p>   | 2     | 2 x 2.1    | <b>ALLOW</b> square or round brackets<br><br><b>ALLOW</b> 'n' in front of the brackets<br><br><b>Second mark is dependent on first</b>  |
|          | (d)     | Nucleotides ✓  | 1     | 1.1        | <b>ALLOW</b> phonetic spelling<br><b>IGNORE</b> bases / names of bases  |
|          | (e) (i) | 2 / two ✓  | 1     | 1.1        |   |
|          | (ii)    |  <p>Correct  linkage ✓<br/>Rest of structure correct, including 'end' bonds ✓</p> | 2     | 1.1        | <b>ALLOW</b> diagram without brackets and n<br><br><b>DO NOT ALLOW</b> -COO- /  H -<br><br><b>Second mark is dependent on first</b> |
|          | (iii)   | H <sub>2</sub> O ✓   | 1     | 1.1        | <b>ALLOW</b> 2H <sub>2</sub> O<br><b>DO NOT ALLOW</b> water   |

| Question |      | Answer   | Marks | AO element     | Guidance   |
|----------|------|--|-------|----------------|--|
| (f)      | (i)  | <p><b>ANY THREE FROM:</b></p> <p>Idea of pouring hexanedioyl dichloride on top of the (diamine) solution (so that mixing is minimised) ✓</p> <p>Use of glass rod or pouring down side of beaker to minimise mixing ✓</p> <p>Idea of picking up (film of) nylon at interface (of layers with tweezers) ✓</p> <p>Idea of lifting and drawing out thread of nylon (slowly) from beaker ✓</p> <p>Idea of washing the thread of nylon (to remove any corrosive chemicals) ✓</p> | 3     | 3 x 1.2        | <p><b>ALLOW</b> idea of pouring one solution on top of the other solution</p> <p><b>IGNORE</b> just mixing the solutions</p> <p><b>ALLOW</b> idea of (film of) nylon formed at the interface (of layers)</p>   |
|          | (ii) | <p><b>ANY THREE FROM:</b></p> <p>Avoid naked flames or sources of ignition because solvent is highly flammable ✓</p> <p>Wear (disposable nitrile) gloves because reagents are corrosive ✓</p> <p>Wear eye protection because reagents are corrosive ✓</p> <p>Lab well ventilated / use of fume cupboard because of fumes from chemicals ✓</p>  | 3     | 1.2 x 2<br>2.2 | <p><b>Safety precaution must be linked to correct explanation for the mark</b></p> <p><b>IGNORE</b> avoid heat sources</p> <p><b>IGNORE</b> idea of wearing gloves simply to stop reagents getting on hands or to protect hands, BUT <b>ALLOW</b> idea of wearing gloves to avoid <b>damage</b> to skin (by chemicals)</p> <p><b>IGNORE</b> idea of wearing eye protection simply to stop reagents getting in eyes or to protect eyes, BUT <b>ALLOW</b> idea of wearing eye protection to avoid <b>damage</b> to eyes (by chemicals)</p> |

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