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# Mark Scheme (Results)

November 2020

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

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## General Marking Guidance

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

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

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

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

|     |    |                                           |                                                                                                                             |
|-----|----|-------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------|
|     |    | description of the plan/method/experiment |                                                                                                                             |
| AO3 | 3b |                                           | An explanation that combines identifying an improvement of the experimental procedure with a linked justification/reasoning |

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

| Question number | Answer                                                                                                                                                                                                                                                     | Mark |
|-----------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|
| 1(a)            | <p><b>D</b> fluorine atom, chloride ion, nanoparticle is the only correct answer.</p> <p><b>A</b> and <b>B</b> are not correct because the smallest particle is the atom<br/> <b>C</b> is not correct because the largest particle is the nanoparticle</p> | (1)  |

| Question number | Answer                                                                                                                                                                             | Mark |
|-----------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|
| 1(b)(i)         | <p>in either order:</p> <ul style="list-style-type: none"> <li>• silver nitrate / <math>\text{AgNO}_3</math> (1)</li> <li>• nitric acid / <math>\text{HNO}_3</math> (1)</li> </ul> | (2)  |

| Question number | Answer                                                                                                                                                                                                                                             | Additional guidance                                                                                                                                                                                 | Mark |
|-----------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|
| 1(b)(ii)        | <p>An explanation to include any two from</p> <ul style="list-style-type: none"> <li>• bromides give a cream (precipitate) (1)</li> <li>• iodides give a yellow (precipitate) (1)</li> <li>• other ions also may give these colours (1)</li> </ul> | <p>allow 'bromine' for bromide<br/> allow 'iodine' for iodide</p> <p>allow there are {2 colours/ mix of colours} so there is more than one ion (1)<br/> allow it could be bromide or iodide (1)</p> | (2)  |

| Question number | Answer               | Additional guidance                         | Mark |
|-----------------|----------------------|---------------------------------------------|------|
| 1(b)(iii)       | flame photometer (1) | allow any suitable method except flame test | (1)  |

|  |  |  |  |
|--|--|--|--|
|  |  |  |  |
|--|--|--|--|

| Question number | Answer  | Additional guidance                                                                | Mark |
|-----------------|---------|------------------------------------------------------------------------------------|------|
| 2(a)(i)         | 2.8.8.1 | allow any separator including gaps e.g. 2 8 8 1<br><br>send to review any diagrams | (1)  |

| Question number | Answer                                                                                                                                                                                                                                           | Mark |
|-----------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|
| 2(a)(ii)        | B 19 (protons) 20 (neutrons) is the only correct answer.<br><br>A is incorrect because there are 20 neutrons in the ion<br>C is incorrect because there are 19 protons and 20 neutrons<br>D is incorrect because there are 19 protons in the ion | (1)  |

| Question number | Answer                                                                                                                                                     | Additional guidance                                                                                                                                                       | Mark |
|-----------------|------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|
| 2(b)            | An explanation linking <ul style="list-style-type: none"> <li>outer (electron) shell (1)</li> <li>(both have) {same number / 1} electron(s) (1)</li> </ul> | allow both lose 1 electron (to form ion / to form noble gas configuration)<br><br>reject same number of outer shells / same number of electrons<br><br>MP2 depends on MP1 | (2)  |





| Question number | Answer                                                                                                                                                                                 | Additional guidance                                                                                             | Mark |
|-----------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------|------|
| 2(c)            | <p>An explanation linking</p> <ul style="list-style-type: none"> <li>• (intermolecular) forces are weak (1)</li> <li>• little <b>energy</b> needed (to overcome forces) (1)</li> </ul> | <p>allow intermolecular bonds / weak bonds between molecules</p> <p>ignore needs a low temperature to break</p> | (2)  |

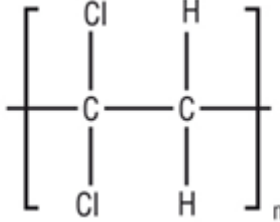
| Question number | Answer                                                                                                     | Additional guidance | Mark |
|-----------------|------------------------------------------------------------------------------------------------------------|---------------------|------|
| 2(d)            | $2\text{K (s)} + \text{F}_2\text{(g)} \rightarrow 2\text{KF (s)}$ <p>2 K (1)<br/>2 KF (1)<br/>s, s (1)</p> | ignore words        | (3)  |

| Question number | Answer                                         | Additional guidance        | Mark |
|-----------------|------------------------------------------------|----------------------------|------|
| 3(a)            | larger surface area {higher /faster} rate /ORA | answer must be comparative | (1)  |

| Question number | Answer                                                                                                                                                                                                                                                                                                                                                         | Additional guidance                                                                                                                                     | Mark |
|-----------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------|------|
| 3(b)            | <p>final answer of 0.3 with or without working scores 3</p> <p>MP1 : conversion of time from minutes into seconds<br/> <math>5 \times 60 = 300</math> (seconds) (1)</p> <p>MP2 : rate = volume / time<br/> rate = <math>\frac{90}{300}</math> (1)</p> <p>MP3 : evaluation of the <u>fraction</u><br/> = <math>0.3 \text{ (cm}^3 \text{ s}^{-1})</math> (1)</p> | <p>allow</p> <p><math>90/5</math> (1)</p> <p><math>90/5 = 18</math> (2)</p> <p><math>300/90 = 3.33</math> (2)</p> <p><math>5/90 = 0.0556</math> (1)</p> | (3)  |

| Question number | Answer                                                                                                                                                                                                                                                                                                                                                                       | Additional guidance                                                                                                                                                                                                                                             | Mark |
|-----------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|
| 3(c)            | <p>An explanation linking three of the following</p> <ul style="list-style-type: none"> <li>particles have more energy (1)</li> <li>so (particles) move <u>faster</u> (1)</li> <li>(so) there are more frequent collisions between particles (1)</li> <li>higher proportion of collisions have at least the activation energy to react when particles collide (1)</li> </ul> | <p>Allow more kinetic energy for MP1 and MP2</p> <p>needs to be comparative</p> <p>allow greater chance of collision</p> <p>allow higher {proportion / chance} of collisions are successful / productive</p> <p>allow more particles have activation energy</p> | (3)  |

| Question number | Answer                                                                                                                                                                                                                                            | Additional guidance                                                                  | Mark |
|-----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|------|
| 4(a)(i)         | <p>A description to include any two from</p> <ul style="list-style-type: none"> <li>• double bond (in monomer) {breaks/ opens up} (1)</li> <li>• {monomers/ molecules} {link/ join} together (1)</li> <li>• to form a (long) chain (1)</li> </ul> | <p>diagrams can score MP1, 2 or 3<br/>ignore mention of addition or condensation</p> | (2)  |

| Question number | Answer                                                                                                                                                                                                                                                                                                                                                      | Additional guidance |
|-----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|
| 4(a)(ii)        | <p>  <br/>           B is the only correct answer.         </p> <p>           A is not correct as it is poly(1,2-dichloroethene)<br/>           C is not correct as it has a double bond<br/>           D is not correct as it is poly(1,1,2-trichloroethene)         </p> | (1)                 |

| Question number | Answer                                                                                                                                                                                                                                                                                                                                                                                | Additional guidance |
|-----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|
| 4(a)(iii)       | <p>B only the dichloroethene and bromine water goes colourless is the only correct answer</p> <p>           A is incorrect because the alkene decolourises bromine water<br/>           C is incorrect because the polymer does not decolourise bromine water but the alkene does<br/>           D is not correct because the polymer does not decolourise bromine water         </p> | (1)                 |

| Question number | Answer                                                             | Additional guidance |
|-----------------|--------------------------------------------------------------------|---------------------|
| 4(b)            | $C_2H_4 + 2Cl_2 \rightarrow C_2H_2Cl_2 + 2HCl$<br>HCl (1)<br>2 (1) | (2)                 |

| Question number | Answer                                                                                                                                                                                                                                                        | Additional guidance                                                                                                                                                                                                                                                                                                                                           | Mark |
|-----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|
| 4(c)            | An explanation to a property with a linked reason<br><br>non-toxic (1)<br>so stops food being poisonous (1)<br><br>OR<br><br>unreactive (1)<br>so it does not react with the food (1)<br><br>OR<br><br>flexible (1)<br>so it can wrap all around the food (1) | <u>MP2 depends on MP1</u><br><br>allow<br><br>impermeable to air (1)<br>stops food {oxidation / reaction with air} (1)<br>ignore 'stops food going off'<br><br>impermeable to water (1)<br>stops dampening of food (1)<br><br>high melting point (1)<br>so can wrap hot food (without melting) (1)<br><br>ignore: strong/ tough/ transparent/ cheap/ can seal | (2)  |

| Question number | Answer                                                                                                                                                 | Additional guidance                                                                                                                                         | Mark |
|-----------------|--------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------|------|
| 4(d)            | 18 as final answer with or without working scores 3<br><br>$100 - 96.5 = 3.5$ (1)<br>$500 \times 3.5/100 (=17.5)$ (1)<br>$= 18$ (tonnes to 2 s.f.) (1) | 480 as final answer scores 2<br>482.5 / 483 as final answer scores 1<br><br>answer with working using 96.5 and 500 and rounded correctly to 2 s.f. scores 1 | (3)  |

| Question number | Answer                                                                                                                                                                                    | Additional guidance | Mark |
|-----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|------|
| 5(a)(i)         | A description including any 2 of <ul style="list-style-type: none"> <li>• effervescence / fizzing (1)</li> <li>• solid disappears (1)</li> <li>• colourless solution forms (1)</li> </ul> | allow bubbles       | (2)  |

| Question number | Answer                                                                                        | Additional guidance | Mark |
|-----------------|-----------------------------------------------------------------------------------------------|---------------------|------|
| 5(a)(ii)        | type of polymerisation condensation (1)<br>name of other product water / H <sub>2</sub> O (1) | reject addition     | (2)  |

| Question number | Answer  | Additional guidance               | Mark |
|-----------------|---------|-----------------------------------|------|
| 5(a)(iii)       | DNA (1) | allow RNA / deoxyribonucleic acid | (1)  |

| Question number | Indicative content                                                                                                                                       | Mark |
|-----------------|----------------------------------------------------------------------------------------------------------------------------------------------------------|------|
| 5(b)            | An answer to include, in either order <ul style="list-style-type: none"> <li>• use red litmus paper (1)</li> <li>• make litmus paper damp (1)</li> </ul> | (2)  |

| Question number | Answer                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Mark |
|-----------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|
| 5(c)            | <div style="display: flex; align-items: center; justify-content: center; margin-bottom: 20px;"> <div style="border: 1px solid black; padding: 10px; margin-right: 10px;"> <math>\text{CH}_3\text{-CH}_2\text{-CH=CH}_2</math> </div> <div style="margin: 0 10px;">+</div> <div style="border: 1px solid black; padding: 10px; margin-left: 10px;"> <math>\text{H-O-H}</math> </div> </div> <p style="margin-left: 20px;">→     <u>          but-1-ene          </u>     +     <u>          water          </u></p> <p>structure of but-1-ene (1)<br/> name of but-1-ene (1)<br/> structure or formula <b>and</b> name of water (1)</p> | (3)  |

| Question number | Answer                                                                                                                      | Additional Guidance | Mark |
|-----------------|-----------------------------------------------------------------------------------------------------------------------------|---------------------|------|
| 6(a)(i)         | An explanation to include <ul style="list-style-type: none"> <li>a solid/ precipitate (1)</li> <li>of sulfur (1)</li> </ul> |                     | (2)  |

| Question number | Answer                                                                                                                                                                             | Additional Guidance                                                       | Mark |
|-----------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------|------|
| 6(a)(ii)        | A description to include <ul style="list-style-type: none"> <li>flask placed {over/in front of} cross (1)</li> <li>measure time (1)</li> <li>when cross is obscured (1)</li> </ul> | MP2 dependent on MP1<br><br>allow measure how long reaction takes for MP2 | (3)  |

| Question number | Answer                                                                                                                                                                                                                                                                               | Mark |
|-----------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|
| 6(a)(iii)       | <b>B</b> 150 cm <sup>3</sup> is the only correct answer.<br><br><b>A</b> is incorrect because this makes 16.7 g dm <sup>-3</sup> HCl<br><b>C</b> is incorrect because this makes 25.0 g dm <sup>-3</sup> HCl<br><b>D</b> is incorrect because this makes 33.3 g dm <sup>-3</sup> HCl | (1)  |

| Question number | Answer | Additional guidance            | Mark |
|-----------------|--------|--------------------------------|------|
| 6(b)(i)         | iodine | reject iodide; ignore formulae | (1)  |

| Question number | Answer                                                                                                                             | Additional guidance                                     | Mark |
|-----------------|------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------|------|
| 6(b)(ii)        | An explanation to include: <ul style="list-style-type: none"> <li>bromine (1)</li> <li>because electrons are gained (1)</li> </ul> | Mark independently<br><br>allow any number of electrons | (2)  |

| Question number | Answer                                                                                                                                                                                                                                                                                        | Mark |
|-----------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|
| 7(a)            | <p><b>D</b> nitrogen, oxygen, argon is the only correct answer</p> <p><b>A</b> is not correct because nitrogen is the most common gas<br/> <b>B</b> is not correct because hydrogen is not the third most common gas<br/> <b>C</b> is not correct because nitrogen is the most common gas</p> | (1)  |

| Question number | Answer                                                                                                             | Additional guidance                                                       | Mark |
|-----------------|--------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------|------|
| 7(b)(i)         | <p>mass argon = 79.120 – 78.639 (= 0.481 (g)) (1)</p> <p>density = 0.481/250 = 0.001924 (gcm<sup>-3</sup>) (1)</p> | <p>allow ECF<br/> allow 0.002, 0.0019, 0.00192, 0.001924..... for (2)</p> | (2)  |

| Question number | Answer                                                                                                                                                                                                                                                                                               | Additional guidance                                 | Mark |
|-----------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------|------|
| 7(b)(ii)        | <p>An explanation including</p> <ul style="list-style-type: none"> <li>the volume of the flask is more than 250 cm<sup>3</sup> / more argon is in the flask than up to the line (1)</li> <li>measure the whole volume of the flask (e.g. fill with water and measure volume of water) (1)</li> </ul> | <p>allow use a flask/ container of known volume</p> | (2)  |

| Question number | Answer                           | Additional guidance                                                                                                                      | Mark |
|-----------------|----------------------------------|------------------------------------------------------------------------------------------------------------------------------------------|------|
| 7(c)            | helium, neon, argon, krypton (2) | <p>krypton, argon, neon, helium (1)</p> <p>if order correct except that two adjacent elements transposed allow 1<br/> allow formulae</p> | (2)  |



| Question number | Indicative content                                                                                                              | Mark |
|-----------------|---------------------------------------------------------------------------------------------------------------------------------|------|
| 7(d)            | $2 \text{CaCO}_3 + \text{Mg}^{2+} \rightarrow \text{CaMg}(\text{CO}_3)_2 + \text{Ca}^{2+}$ <p>2 (1)<br/>Mg<sup>2+</sup> (1)</p> | (2)  |

| Question number | Indicative content                                                                                                                                                                                                                                        | Additional guidance                                                                                       | Mark |
|-----------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------|------|
| 7(e)            | <p>An explanation to include</p> <p>Q is early atmosphere (0) because</p> <ul style="list-style-type: none"> <li>limewater ppt faster so contains {more/large amount of} carbon dioxide (1)</li> <li>splint goes out so {little/no oxygen} (1)</li> </ul> | <p>If P given then (0)</p> <p>If neither P nor Q stated they must be clearly referring to Q to score.</p> | (2)  |

| Question number | Answer                                                                                                                                                                                                                                                              |                                                                                                                                                                 | Mark |
|-----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|------|
| 8(a)(i)         | A description to include any three from <ul style="list-style-type: none"> <li>metal disappears (1)</li> <li>metal moves around (1)</li> <li>fizzing/ effervescence/ bubbling (1)</li> <li>(any colour) flame (1)</li> <li>explodes/reacts violently (1)</li> </ul> | ignore floats/ sinks/ on surface of water<br>allow dissolves/gets smaller<br>ignore gas / smoke / steam / water vapour / hydrogen<br>allow forms a ball / melts | (3)  |

| Question number | Answer                                                                                                                                                                                        | Mark |
|-----------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|
| 8(a)(ii)        | <b>C</b> rubidium atoms outer electrons are further from the nucleus than potassium atoms is the only correct answer.<br><b>A, B</b> and <b>D</b> are true but does not affect the reactivity | (1)  |

| Question number | Answer                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Additional guidance                                                        | Mark |
|-----------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------|------|
| 8(a)(iii)       | 4.08 as final answer with or without working scores 4 <ul style="list-style-type: none"> <li>moles Rb = <math>8.5/85</math> (= 0.1 mol) (1)</li> <li>moles RbOH = 0.1 mol (1)</li> <li>mass RbOH = <math>0.1 \times 102</math> (=10.2 g) (1)</li> <li>conc = <math>10.2/2.5</math> (= 4.08 gdm<sup>-3</sup>) (1)</li> </ul> <b>OR</b> <ul style="list-style-type: none"> <li><math>2\text{Rb} \rightarrow 2 \text{RbOH}</math>/ 1:1 ratio (1)</li> <li><math>85</math> (x2) (g) <math>\rightarrow</math> <math>102</math> (x2) (g) (1)</li> <li><math>8.5</math> (g) <math>\rightarrow</math> <math>10.2</math> (g) (1)</li> <li>conc = <math>10.2/2.5</math> (= 4.08 gdm<sup>-3</sup>) (1)</li> </ul> | allow 8.5/ 2.5 (=3.4) to score MP4<br>working leading to 10.2 will score 3 | (4)  |

| Question number | Answer                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Mark       |
|-----------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|
| <b>8(b)</b>     | <p><math>(\text{NH}_4)_2\text{CO}_3 + 2\text{RbOH} \rightarrow \text{Rb}_2\text{CO}_3 + 2\text{NH}_3 + 2\text{H}_2\text{O}</math> <b>(3)</b></p> <p>Four formulae on correct side of equation (regardless of any other formulae, correct or otherwise) <b>(1)</b><br/>Equation with all five formulae and no others <b>(2)</b><br/>Fully correct balanced equation <b>(3)</b></p> <p>do not penalise incorrect subscripts/ superscripts/ small letters/ capital letters. Ignore state symbols.</p> | <b>(3)</b> |

| Question number | Answer                                                                                                                                                                                                       | Additional guidance | Mark |
|-----------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|------|
| 9(a)            | <ul style="list-style-type: none"> <li>• (funnel) heat (energy) released in reaction/ exothermic reaction (1)</li> <li>• ( liquid) water (1)</li> <li>• (gas) sulfur dioxide / carbon dioxide (1)</li> </ul> | ignore NOx          | (3)  |

| Question number | Answer                                                                                                                                                                                                                                                                                                                                                                     | Additional guidance | Mark |
|-----------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|------|
| 9(b)            | <p>-730 as final answer with or without working scores 4<br/> +730 as final answer with or without working scores 3</p> <p>bonds broken = <math>(4 \times 435) + (2 \times 496) = 2732</math> (1)<br/> bonds made = <math>(2 \times 805) + (4 \times 463) = 3462</math> (1)<br/> energy change = broken – made (1) [2732 – 3462]<br/> = -730 (kJ mol<sup>-1</sup>) (1)</p> | allow ECF           | (4)  |

| Question number | Indicative content                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Mark                     |
|-----------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------|
| *9(c)           | <p>Answers will be credited according to candidates' deployment of knowledge and understanding of the material in relation to the qualities and skills outlines in the generic markscheme.</p> <p>The indicative content below is not prescriptive and candidates are not required to include all the material which is indicated as relevant. Additional content included in the response must be scientific and relevant.</p> <p><b>Pollutants</b></p> <ul style="list-style-type: none"> <li>• carbon monoxide combines with haemoglobin so is toxic</li> <li>• nitrogen oxides are acidic / toxic</li> <li>• nitrogen oxides lead to acid rain</li> <li>• references to effects of acid rain – e.g. damages buildings/kills plants etc</li> <li>• carbon dioxide is a greenhouse gas</li> <li>• greenhouse gases cause global warming</li> <li>• references to effects of global warming – e.g sea levels rising etc</li> <li>• particulates cause breathing difficulties/ make buildings dirty</li> </ul> <p><b>Petrol/diesel comparison</b></p> <ul style="list-style-type: none"> <li>• compared to diesel, petrol: <ul style="list-style-type: none"> <li>-releases less nitrogen oxides</li> <li>-releases less particulates</li> </ul> </li> <li>• compared to petrol, diesel: <ul style="list-style-type: none"> <li>-releases more carbon monoxide</li> <li>-releases more carbon dioxide</li> </ul> </li> </ul> <p><b>Catalytic converter</b></p> <ul style="list-style-type: none"> <li>• reduces carbon monoxide</li> <li>• reduces nitrogen oxides</li> </ul> <p><b>Overall comparison</b></p> <ul style="list-style-type: none"> <li>• Petrol car improved with catalytic converter as two pollutants reduced</li> <li>• Diesel better than petrol for carbon oxides</li> <li>• Diesel is worse for particulates and nitrogen oxides</li> </ul> | (6)<br>EXP<br>AO3<br>(6) |

All incorrect/ irrelevant/ vague information to be ignored, unless contradictory. Ignore references to ozone layer.

| Level   | Mark | Descriptor                                                                                                                                                                                                                                                                                                                                                                         | Example responses                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|---------|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|         | 0    | No rewardable material.                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Level 1 | 1–2  | Demonstrates elements of chemical knowledge some of which is inaccurate. Presents a discussion with some structure and coherence.<br><br>States differences between engines using information from the table or explains the problem of one of the pollutants.                                                                                                                     | e.g. The diesel engine gives off the least carbon dioxide (1)<br>carbon dioxide causes the greenhouse effect (1)<br>the diesel engine only gives off particulates which cause breathing problems (2)                                                                                                                                                                                                                                                                                                                                                                                            |
| Level 2 | 3–4  | Demonstrates elements of chemical knowledge and understanding some of which is mostly relevant but which may contain some inaccuracies. Presents a discussion that has structure and is mostly coherent.<br><br>Describes two or three differences between engines using information from the table and explains the problems of some of the pollutants.                           | e.g. the petrol engines give off carbon dioxide but the one with a catalytic converter gives off less nitrogen oxides. The carbon dioxide is a greenhouse gas which causes global warming and the nitrogen oxide cause acid rain (4)                                                                                                                                                                                                                                                                                                                                                            |
| Level 3 | 5–6  | Demonstrates accurate and relevant chemical knowledge and understanding. Presents a discussion and comparison with some structure and coherence.<br><br>Describes three or four differences between engines using information from the table and explains the problem of some of the pollutants. Explains why one of the engines causes the least/ most damage to the environment. | e.g. the petrol engines give off carbon dioxide but the one with a catalytic converter gives off less nitrogen oxides. The diesel engine gives off less carbon dioxide but more nitrogen oxides. The carbon dioxide is a greenhouse gas which causes global warming and the nitrogen oxide cause acid rain. The diesel engine gives off the least carbon monoxide which is toxic. Overall the petrol car with no catalytic converter because it gives off the a lot of carbon dioxide and more carbon monoxide so it would cause the most global warming and breathing problems from the CO (6) |

| Question number | Answer                                                                                | Additional guidance                                                                                                                                                | Mark |
|-----------------|---------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|
| 10(a)(i)        | <ul style="list-style-type: none"> <li>• add yeast (1)</li> <li>• warm (1)</li> </ul> | accept zymase / enzymes<br>accept any sensible method of warming eg waterbath<br>reject boiling<br>allow 'heat' only if temperature range within 20-45°C specified | (2)  |

| Question number | Answer                                                                                                                                                                                               | Additional guidance                       | Mark |
|-----------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------|------|
| 10(a)(ii)       | A description to include <ul style="list-style-type: none"> <li>• add fractional distillation column/fractionating column (1)</li> <li>• in neck of flask/between flask and condenser (1)</li> </ul> | allow use fractional distillation for MP1 | (2)  |

| Question number | Answer                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Additional guidance | Mark |
|-----------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|------|
| 10(b)           | 66 (g) as final answer with or without working scores 3 <ul style="list-style-type: none"> <li>• mol carbohydrate = <math>135/180 = 0.75</math> mol (1)</li> <li>• mol of carbon dioxide = <math>0.75 \times 2 = 1.5</math> mol (1)</li> <li>• mass = <math>1.5 \times 44 = 66(g)</math> (1)</li> </ul> <p><b>OR</b></p> <ul style="list-style-type: none"> <li>• 180g carbohydrate → <math>2 \times 44g (=88g)</math> carbon dioxide (1)</li> <li>• 135g carbohydrate → <math>135/180 \times 2 \times 44g</math> carbon dioxide (1)</li> <li>• = 66(g) (1)</li> </ul> | 33 scores 2.        | (3)  |

| Question number | Indicative content                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Mark       |
|-----------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|
| *10(c)          | <p>Answers will be credited according to candidates' deployment of knowledge and understanding of the material in relation to the qualities and skills outlines in the generic markscheme.</p> <p>The indicative content below is not prescriptive and candidates are not required to include all the material which is indicated as relevant. Additional content included in the response must be scientific and relevant.</p> <p><b>AO1 (3) and AO2 (3)</b></p> <p><b>Formula</b></p> <ul style="list-style-type: none"> <li>• same general formula</li> <li>• <math>C_nH_{2n+1}COOH</math></li> <li>• same functional group</li> <li>• functional group is <math>-COOH</math></li> <li>• members differ by <math>CH_2</math></li> <li>• formula mass increases by 14</li> <li>• they are carboxylic acids</li> </ul> <p><b>Physical properties</b></p> <ul style="list-style-type: none"> <li>• trend in physical properties</li> <li>• density falls</li> <li>• boiling point increases</li> </ul> <p><b>Chemical properties</b></p> <ul style="list-style-type: none"> <li>• similar chemical {properties/ reactions}</li> <li>• all react with alcohols</li> <li>• form esters</li> <li>• all react with sodium hydroxide solution</li> <li>• form sodium salts</li> <li>• they are all acids</li> </ul> | <b>(6)</b> |



| Level   | Mark | Descriptor                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | Additional Guidance                                                                                                                                                                                                                                                                                 |
|---------|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|         | 0    | No rewardable material.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | e.g. they all have similar reactions<br>they all have high/low density<br>they have similar densities                                                                                                                                                                                               |
| Level 1 | 1–2  | <ul style="list-style-type: none"> <li>• Interpretation and evaluation of the information attempted but will be limited with a focus on mainly just one variable. Demonstrates limited synthesis of understanding. (AO3)</li> <li>• The explanation attempts to link and apply knowledge and understanding of scientific ideas, flawed or simplistic connections made between elements in the context of the question. (AO2)</li> </ul> <p>States information from the table or states that are carboxylic acids.</p> | they all have COOH (1)<br>they are carboxylic acids because they all have COOH (2)<br>they all react with alcohols and sodium hydroxide (2)                                                                                                                                                         |
| Level 2 | 3–4  | <ul style="list-style-type: none"> <li>• Interpretation and evaluation of the information on both variables, synthesising relevant understanding. (AO3)</li> <li>• The explanation is mostly supported through linkage and application of knowledge and understanding of scientific ideas, some logical connections made between elements in the context of the question. (AO2)</li> </ul> <p>Uses the table to draw deductions</p>                                                                                   | The formula show that they differ by CH <sub>2</sub> each time and they all have the same functional group, COOH, so they are carboxylic acids (4)<br>they all react with alcohols to form an ester and water, they all react with sodium hydroxide and they all have the same functional group (4) |
| Level 3 | 5–6  | <ul style="list-style-type: none"> <li>• Interpretation and evaluation of the information, demonstrating throughout the skills of synthesising relevant understanding. (AO3)</li> <li>• The explanation is supported throughout by linkage and application of knowledge and understanding of scientific ideas, logical connections made between elements in the context of the question. (AO2)</li> </ul> <p>Uses the table to draw deductions and describes a <b>pattern</b></p>                                     | e.g. they all react with alcohols to form an ester and water, they all react with sodium hydroxide and they all have the same functional group and as molecules get bigger.... density falls<br>....boiling point rises                                                                             |