# Mark Scheme (Results)

## Summer 2022

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.

1CH0/2H 2206 Paper 2 Higher Tier

| Question number | Answer | Additional guidance | Mark |
|---|---|---|---|
| 1(a)(i) | colourless / absorbs UV / non-toxic / large SA : vol ratio | allow transparent / does not leave white marks<br>allow reflects UV | (1)<br>AO2 1 |

| Question number | Answer | Additional guidance | Mark |
|---|---|---|---|
| 1(a)(ii) | long term effects not known/ may build up in {living things/ water supplies/ environment} | allow specific examples of effects on health but ignore 'health risks'<br><br>allow may get into the body and cause harm | (1)<br>AO1 1 |

| Question number | Answer | Additional guidance | Mark |
|---|---|---|---|
| 1(b)(i) | as the diameter of the nanoparticle increases the surface area<br>volume ratio decreases | ORA<br><br>allow negative correlation/inversely proportional<br><br>ignore that as volume increases surface area also increases | (1)<br>AO3 1 |

| Question number | Answer | Mark |
|---|---|---|
| 1(b)(ii) | B 3 : 40 is the only correct answer.<br><br>A is the correct ratio for a 70nm diameter sphere<br>C is the correct ratio for a 90nm diameter sphere<br>D is the correct ratio for a 100nm diameter sphere | (1)<br>AO3 1 |

| Question number | Answer | Additional guidance | Mark |
|---|---|---|---|
| 1(c) | calculate surface area<br>60 x 60 x 6 (= 21 600 ) (1)<br><br>calculate volume<br>60 x 60 x 60 (= 216 000 ) (1)<br><br>s.a : vol ratio<br><br>$\frac{216000}{21600}$ (1) (= 10) | allow 10 : 1 (or multiples of) with calculation<br>ignore = instead of : | (3)<br>AO2 1 |

(Total for question 1 = 7 marks)

| Question number | Answer | Additional Guidance | Mark |
|---|---|---|---|
| 2(a)(i) | • 100 $cm^3$ measuring cylinder/ (gas) syringe (1)<br><br>• which has smaller gradations / higher resolution (1) | allow 'smaller measuring cylinder'<br>ignore gas measurer<br>reject (upturned) burette for MP1<br><br>MP2 is dependent on MP1<br>allow (more) precise / (more) accurate<br>allow smaller measurements/ increments<br>ignore easier to use / no gas will escape | (2)<br>AO3 3b |

| Question number | Answer | Additional guidance | Mark |
|---|---|---|---|
| 2(a)(ii) | • volume read at 90s = 29 $cm^3$ (1)<br><br>• rate = $\frac{\text{volume}}{90}$ (1)<br><br>• = 0.3222…. ($cm^3$ per second) (1) | 0.31, 0.32, 0.33 with or without working scores 3<br>0.3 alone scores 0<br>all other answers require working to have marks awarded<br><br>allow any value 28-30<br>ECF for incorrect volume<br><br>ECF if fraction inverted<br>ECF if 1.5 used instead of 90<br>eg<br>$\frac{28/29/30}{1.5}$ = 18.66…/ 19.33…/ 20 scores 2<br><br>MP3 must be decimal value correctly rounded – ignore fractions | (3)<br>AO3 2 |

| Question number | Answer | Additional guidance | Mark |
|---|---|---|---|
| 2(a)(iii) | volumes were {constant / stopped rising}<br><br>OR<br><br>graph was {flat/plateaued/ levelled off} | allow reactant(s) used up / limiting factor<br>allow no more hydrogen evolved<br>allow EVIDENCE that reaction stopped: measurements stayed the same/ no more bubbles<br><br>allow graph has reached zero gradient<br>ignore graph is a straight line<br>ignore it has reached the highest {point / volume}<br><br>ignore reaction has stopped / is complete<br>reject reaction is becoming slower | (1)<br>AO3 2 |

| Question number | Answer | Additional guidance | Mark |
|---|---|---|---|
| 2(b)(i) | An explanation linking<br>• more particles present (in same volume) (1)<br><br>• so more frequent collisions/ more chance of collision (1) | allow atoms/ molecules/ ions for particles<br>ignore more acid present<br><br>allow more collisions per {sec/min/unit time}<br>ignore more collisions/ more successful collisions<br>ignore references to energy / moving faster<br><br>mark independently | (2)<br>AO1 1 |

| Question number | Answer | Mark |
|---|---|---|
| 2(b)(ii) | D use the same metal but in a powdered form is the only correct answer<br><br>B and C are incorrect because the reactants are not changed<br>A is incorrect because the reaction will be slower | (1)<br>AO2 1 |

(Total for question 2 = 9 marks)

| Question number | Answer | Mark |
|---|---|---|
| 3(a) | B effervescense is seen is the only correct answer.<br><br>A, C and D are incorrect as they are not linked to gas production | (1)<br>AO1 2 |

| Question number | Answer | Mark |
|---|---|---|
| 3(b) | B chlorine is the only correct answer.<br><br>A, C and D are incorrect because only chlorine bleaches litmus. | (1)<br>AO1 1 |

| Question number | Answer | Additional guidance | Mark |
|---|---|---|---|
| 3(c) | 2.20 with or without working scores (2)<br><br>• 5(.000) − 2.8(00) = 2.2(00) (1)<br><br>• = 2.20 (1) | reject additional processing for MP1 (e.g 5 − 2.8 = 2.2 then $\frac{2.2}{100}$ = 0.0220)<br>does not score MP1 − additional process of dividing by 100<br>does not score MP2 - using a number not in the question<br><br>for MP2 final answer must be to 3sf, correct evaluation of expression using only numbers from the question<br>2.2 / 2.200 scores 1 mark<br><br>$\frac{5.000}{2.800}$ = 1.79 scores 1 mark<br>$\frac{2.800}{5.000}$ = 0.560 scores 1 mark [0.56 = 0]<br>5.000 x 2.800 = 14.0 scores 1 mark [14 = 0]<br>5.000 + 2.800 = 7.80 scores 1 mark [7.8 = 0] | (2)<br>AO2 1 |

| Question number | Answer | Additional guidance | Mark |
|---|---|---|---|
| 3(d)(i) | An explanation linking:<br>• it has two electrons in outer shell/ it has a full outer shell / OWTTE (1)<br>• so does not {gain/ lose/ transfer/ share} electrons (1) | MP1 – reject if number of electrons in outer shell is stated and not 2<br>ignore references to protons and neutrons<br>allow helium has two electrons in its (only) shell / helium's (only) shell is full<br>ignore helium does not need to react | (2)<br>AO1 1 |

| Question number | Answer | Additional guidance | Mark |
|---|---|---|---|
| 3(d)(ii) | less dense than air | allow less dense than nitrogen<br>allow low density / not (very) dense<br>allow diffuses slowly out of balloon<br>ignore less dense than oxygen<br>ignore it is a gas / light / lightweight / inert/ unreactive/ non-flammable / lighter than air / makes balloon float / it rises/ it floats<br>ignore non-toxic / not poisonous | (1)<br>AO2 1 |

| Question number | Answer | Additional guidance | Mark |
|---|---|---|---|
| 3(e) | $4.214 \times 10^{24}$ with or without working scores (2)<br>2 x 3.5 (1) (= 7(.0))<br>7(.0) x $6.02 \times 10^{23}$ (1) (= $4.214 \times 10^{24}$)<br>OR<br>3.5 x $6.02 \times 10^{23}$ (1) (= $2.107 \times 10^{24}$)<br>2 x $2.107 \times 10^{24}$ (1) (= $4.214 \times 10^{24}$) | allow any number of sig figs except 1 for full marks<br>allow answer not in standard form | (2)<br>AO2 1 |

(Total for question 3 = 9 marks)

| Question number | Answer | Additional guidance | Mark |
|---|---|---|---|
| 4(a)(i) | An explanation linking<br>• corrosive (1)<br>• so wear gloves/ (safety) goggles (1) | allow safety glasses/ safety spectacles / eye protection<br>ignore glasses and any other precautions<br><br>mark independently | (2)<br>A03 3a |

| Question number | Answer | Mark |
|---|---|---|
| 4(a)(ii) | nitric acid | (1)<br>AO1 1 |

| Question number | Answer | Additional guidance | Mark |
|---|---|---|---|
| 4(a)(iii) | inert/ unreactive/ does not corrode | reject 'is not corrosive'<br><br>allow acid will not dissolve/ react with glass<br><br>ignore 'acid won't burn through'<br>ignore references to clear / strong | (1)<br>AO2 1 |

| Question number | Answer | Additional guidance | Mark |
|---|---|---|---|
| 4(b)(i) | An explanation linking<br><br>• hold the wire in the flame / at the tip of the (blue) cone (1)<br>• (as) it is hotter (1) | if the wire has been placed <u>in the flame</u> then any colour of flame is allowed.<br>if the wire has not been placed in the flame then allow use of a blue/roaring flame/open air hole, but NOT any other specified colours of roaring flame. | (2)<br>AO1 2 |

| Question number | Answer | Additional guidance | Mark |
|---|---|---|---|
| 4(b)(ii) | P: lithium / Li (1)<br>Q: potassium / K (1)<br>R: copper / Cu (1) | for P allow strontium / Sr<br>ignore any charges, even if incorrect (e.g. allow $Li^+$, $Li^{2+}$)<br>do not penalise incorrect capital/small letters (e.g. allow CU, li) | (3)<br>AO1 2 |

| Question number | Answer | Additional guidance | Mark |
|---|---|---|---|
| 4(c) | 20 x 5/1000 x 219 (2) (= 21.9 g)<br><br>• 5/1000 (= 0.005) (1)<br><br>• 20 x 0.005 x 219 (1) (= 21.9 g) | overall calculation is 5 x 219 x 20 / 1000<br>deduct 1 mark per error<br><br>allow ECF for MP2<br><br>21900 scores 1 (has not /1000)<br><br>219 with working scores 1 (has used 100 not 1000) | (2)<br>AO2 1 |

(Total for question 4 = 11 marks)

| Question number | Answer | Additional guidance | Mark |
|---|---|---|---|
| 5(a)(i) | diesel releases more (nitrogen oxides / $NO_x$) (per km driven) / ORA (1)<br><br>diesel releases more particulates (per km driven) / ORA (1) | ignore just quoting numbers from the table<br><br>answer does need to make comparison – can be shown by statements about diesel and petrol<br><br>ignore any effect of pollutants<br>ignore anything about rights and wrongs of either $NO_x$ or particulates | (2)<br>AO3 1 |

| Question number | Answer | Additional guidance | Mark |
|---|---|---|---|
| 5(a)(ii) | an explanation linking<br><br>• diesel releases less carbon dioxide (1)<br>• which is a greenhouse gas/contributes to global warming (1)<br><br>OR<br>• diesel releases less sulfur dioxide (1)<br>• which causes acid rain (1) | vague references to pollution / harms environment do need to be qualified for any MP2<br><br>allow climate change<br>ignore effects of climate change<br><br>ignore carbon monoxide / unburnt hydrocarbons<br>ignore ozone / ozone layer / effects of acid rain<br><br>reject particulates<br><br>MP2 depends on MP1 | (2)<br>AO3 2 |

| Question number | Answer | Mark |
|---|---|---|
| 5(b)(i) | D their viscosity increases as the molecules get larger is the only correct answer<br><br>A, B, C are incorrect statements | (1)<br>AO1 1 |

| Question number | Answer | Mark |
|---|---|---|
| 5(b)(ii) | C $C_4H_{10}$ is the only correct answer<br><br>A, B and D are not alkanes | (1)<br>AO2 1 |

| Question number | Answer | Additional guidance | Mark |
|---|---|---|---|
| 5(b)(iii) | $2\ C_8H_{18} + 25\ O_2 \rightarrow 16\ CO_2 + 18\ H_2O$<br><br>LHS formulae → (1)<br>→ RHS formulae (1)<br>balancing correct formulae (1) | allow multiples including halves<br><br>ignore any state symbols | (3)<br>AO2 1 |

(Total for question 5 = 9 marks)

| Question number | Answer | Additional guidance | Mark |
|---|---|---|---|
| 6(a) | bromine | ignore Br | (1)<br>AO1 1 |

| Question number | Answer | Additional guidance | Mark |
|---|---|---|---|
| 6(b) | An explanation linking<br><br>• outer {shell / electron(s)} is further from nucleus in iodine/ORA (1)<br><br><br><br><br><br><br><br>• {force / attraction} between nucleus and (electrons in) outer shell is less in iodine/ORA(1)<br>• iodine does not gain (an) electron(s) as readily/ORA (1) | accept reverse argument throughout<br><br>allow iodine has more shells / larger atomic radius / ORA<br>reject 'more outer shells'<br><br>chlorine has {fewer (electron) shells / smaller atomic radius}<br><br>allow shielding arguments for either MP1 OR MP2 for either iodine or chlorine<br><br>allow outer electrons / incoming electron<br><br><br>if no other mark scored<br>(group 7 elements) gain one electron (when they react) (1) | (3)<br>AO1 1 |

| Question number | Answer | Additional guidance | Mark |
|---|---|---|---|
| 6(c) | sodium chloride | allow NaCl<br>ignore 'salt'<br>reject sodium chlorine / incorrect formula | (1)<br>AO2 1 |

| Question number | Answer | Additional guidance | Mark |
|---|---|---|---|

| | | | |
|---|---|---|---|
| 6(d)(i) | $2Na + Br_2 \rightarrow 2NaBr$<br><br>1 mark for correct formulae<br>1 mark for balancing correct formulae | ignore state symbols even if incorrect | (2)<br>AO2 2 |

| Question number | Answer | Additional guidance | Mark |
|---|---|---|---|
| 6(d)(ii) | turns yellow / orange (liquid / solution) | reject brown as standalone colour<br>ignore brown as in 'yellow-brown'<br>ignore red as in 'red-orange'<br>reject other changes eg effervescence | (1)<br>AO2 2 |

| Question number | Answer | Additional guidance | Mark |
|---|---|---|---|
| 6(d)(iii) | bromide (ions)/ (2)$Br^-$ (1)<br><br>loses/lost electrons (1) | reject bromine / Br<br><br>allow bromine loses electrons for MP2 only<br>reject answers in terms of {chlorine / chloride} being oxidised<br><br>reject $Br_2$ loses electrons | (2)<br>AO1 1 |

(Total for question 6 = 10 marks)

| Question number | Answer | Additional guidance | Mark |
| --- | --- | --- | --- |
| 7(a) | an explanation linking<br>• plants (1)<br>• (produces oxygen by) photosynthesis (1) | allow cyanobacteria / stromatolites<br><br>allow 'photosynthetic organisms' = 2 marks | (2)<br>AO1 1 |

| Question number | Answer | Additional guidance | Mark |
| --- | --- | --- | --- |
| 7(b) | an explanation linking<br>• reheat (and record the mass) (1)<br>• until mass remains constant (1) | allow burn<br>ignore continue heating the magnesium until it no longer glows / all turned white<br><br>'heat to constant mass' = 2 marks | (2)<br>AO1 2 |

| Question number | Answer | Additional guidance | Mark |
| --- | --- | --- | --- |
| 7(c) | $\frac{1.24}{31}$ P (= 0.04) and $\frac{1.6}{16}$ O (= 0.1) (1)<br><br>ratio = 2:5 OR empirical formula = $P_2O_5$ (1)<br><br>relative formula mass $P_2O_5$ = 142 (1)<br><br>molecular formula = $P_4O_{10}$ (1) | full marks can only be obtained with working shown<br><br>allow elements in either order in any formula<br><br>allow ECF from moles of elements calculated<br>allow 1:2.5<br><br>allow 4 : 10 (1)<br><br>allow $\frac{31}{1.24}$ P = 25 and $\frac{16}{1.6}$ O = 10 (0)<br>ratio = 2.5:1 or 5:2 or empirical formula = $P_5O_2$ (1)<br>relative formula mass $P_5O_2$ = 187 (1) | (4)<br>AO2 1 |

| Question number | Answer | Additional guidance | Mark |
|---|---|---|---|
| 7(d)(i) | iron wool {turns orange-brown / rusts} (1)<br>(because) it has {oxidised/ reacted with oxygen} (1)<br><br>OR<br><br>water level in test tube rises (1)<br>(because) oxygen (in the air) has reacted (with the iron) / volume of oxygen (in test tube) has decreased (1) | allow any suitable colour to describe rust<br>ignore changes colour<br>ignore air<br><br>allow volume of air decreases<br><br>the iron turns orange-brown because it has rusted = 2 marks<br><br>allow 1 mark for volume of water (in beaker) decreases due to evaporation | (2)<br>AO2 2 |

| Question number | Answer | Additional guidance | Mark |
|---|---|---|---|
| 7(d)(ii) | replace test tube with a measuring cylinder (1)<br><br>to measure the {volume / amount} of oxygen used up / to measure the change in {volume / amount} of gas in the tube (1) | graduated test tube<br>allow (upturned) burette<br>ignore gas syringe<br><br>allow air in place of gas<br><br>allow gas syringe (0) to measure volume of oxygen used (1)<br>allow use of ruler (1) to measure water heights (1) | (2)<br>AO3 3 |

(Total for question 7 = 12 marks)

| Question number | Answer | Mark |
|---|---|---|
| 8(a)(i) | B solid forms in the solution is the only correct answer.<br><br>A, C, and D are incorrect because a precipitate is a solid (of any colour) | (1)<br>AO2 2 |

| Question number | Answer | Additional guidance | Mark |
|---|---|---|---|
| 8(a)(ii) | A plan including<br>• add named alkaline solution / sodium hydroxide (solution) / potassium hydroxide (solution) (1)<br>• white precipitate forms (in both) (1)<br>• white precipitate dissolves with excess (alkali) indicates $Al^{3+}$ (1)<br>• white precipitate does not dissolve in excess (alkali) indicates $Ca^{2+}$ (1) | accept correct formulae<br>ignore 'alkaline solution'<br><br>accept Al / Ca without charges<br><br>mark independently<br><br>as alternative tests allow<br>• flame test<br>• will show orange red / brick red for $Ca^{(2+)}$<br>for max 2 marks<br><br>or<br>• sulfuric acid<br>• white precipitate for calcium ions<br>for max 2 marks | (4)<br>AO1 2 |

| Question number | Indicative content | Mark |
|---|---|---|
| *8(b) | Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme.<br>The indicative content below is not prescriptive and candidates are not required to include all the material that is indicated as relevant.<br>Additional content included in the response must be scientific and relevant.<br><br>V<br>• does not contain transition metal<br>• because it is white<br>• has ionic bonding<br>• because does not have low melting point, is soluble in water and only conducts when dissolved<br><br>W<br>• it is alkaline gas as litmus turned blue<br>• pungent and alkaline so is ammonia<br><br>X<br>• X is insoluble<br>• it contains bromide ions as a cream ppt formed<br>• which is silver bromide<br><br>Identity of V<br>• V contains ammonium ions<br>• V contains bromide ions<br>• V is ammonium bromide | (6)<br>AO1 1 /<br>AO3 2 |

| Level | Mark | Additional Guidance | General additional guidance – the decision between levels |
|---|---|---|---|
| | 0 | No rewardable material. | Read whole answer and ignore all incorrect material/ discard any contradictory material then: |
| Level 1 | 1-2 | Additional Guidance<br>Correctly identifies at least one of the three compounds<br><br>OR<br><br>Correctly deduces information about at least one of the three compounds | Possible Candidate Responses<br>• V is an ionic compound because it has a high melting point.<br>• W is ammonia<br>• X is (silver) bromide because a cream precipitate is formed on reaction with silver nitrate |
| Level 2 | 3-4 | Additional Guidance<br><br>Correctly identifies two of the three compounds and gives reasons for at least one of the three.<br><br>OR<br><br>Correctly identifies one of the three compounds and gives positive deductions for at least two of the three | Possible Candidate Responses<br>• W is ammonia because it turns red litmus paper blue. X is silver bromide.<br>• V does not contain a transition metal because it is a white solid. W is ammonia. X contains bromide ions because it forms a cream precipitate. |
| Level 3 | 5-6 | Additional Guidance<br>Correctly identifies V and W and gives positive deductions for at least 1<br><br>AND<br><br>That X is (silver) bromide/the solution contains bromide ions | Possible Candidate Responses<br>• W is ammonia because it turns damp red litmus paper blue. X is silver bromide because a cream precipitate formed on reaction with silver nitrate. Therefore V must be ammonium bromide. |

| Level | Mark | Descriptor |
|---|---|---|
| | 0 | • No awardable content |
| Level 1 | 1-2 | • Demonstrates elements of chemical understanding, some of which is inaccurate. Understanding of scientific ideas lacks detail. (AO1)<br>• Presents an explanation with some structure and coherence. (AO1) |
| Level 2 | 3-4 | • Demonstrates chemical understanding, which is mostly relevant but may include some inaccuracies. Understanding of scientific ideas is not fully detailed and/or developed. (AO1)<br>• Presents an explanation that has a structure which is mostly clear, coherent and logical. (AO1) |
| Level 3 | 5-6 | • Demonstrates accurate and relevant chemical understanding throughout. Understanding of the scientific ideas is detailed and fully developed. (AO1)<br>• Presents an explanation that has a well-developed structure which is clear, coherent and logical. (AO1) |

(Total for question 8 = 11 marks)

| Question number | Answer | Mark |
|---|---|---|
| 9(a)(i) | C energy is absorbed energy is released is the only correct answer.<br><br>B, C and D are incorrect because at least one energy change is reversed. | (1)<br>AO1 1 |

| Question number | Answer | Additional guidance | Mark |
|---|---|---|---|
| 9(a)(ii) | • energy change in reactants = 436 + 158 (= 594) (1)<br>• energy change in products = 2 x 562 (= 1124) (1)<br>• overall energy change = 594 − 1124 (1)<br>• = -530 (1) (kJ $mol^{-1}$) | allow ECF throughout<br>ignore sign/unit in MP1<br>ignore sign/unit in MP2<br>MP3 for the difference between MP1 and MP2<br>ignore sign / unit in MP3<br><br>MP4 for correct sign or stating exothermic / endothermic based on MP3<br><br>(+)530 scores 3 marks (loses MP4)<br>(+)64 scores 3 marks (MP1 doubled)<br>-64 scores 2 marks (MP1 doubled and loses MP4)<br>(+)32 scores 3 marks (MP2 not doubled)<br>-32 scores 2 marks (MP2 not doubled and loses MP4) | (4)<br>AO2 1 |

| Question number | Indicative content | Mark |
| --- | --- | --- |
| *9(b) | Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme.<br>The indicative content below is not prescriptive and candidates are not required to include all the material that is indicated as relevant.<br>Additional content included in the response must be scientific and relevant.<br><br>AO1<br>DESCRIPTION<br>• increases the rate of reaction<br>• does not alter products of reaction<br>• is chemically unchanged by reaction<br>• does not get used up<br>• so catalyst mass does not change<br><br>FUNCTION<br>• particles must have minimum energy for reactions to occur<br>• this is called activation energy<br>• reaction proceeds by an alternative route<br>• which reduces activation energy<br>• so a greater proportion of collisions are successful<br><br>DIAGRAM<br>• reaction profile with catalyst has start and end energies the same<br>• because reactants and products the same (label or in text)<br>• new profile has lower peak<br>• this represents lower activation energy (label or in text)<br><br>EXAMPLES<br>• Haber process to make ammonia uses iron catalyst<br>• cracking to make smaller alkanes uses catalyst<br>• (fermentation) to make alcoholic drinks uses (yeast which contains) an enzyme<br>• hydrogen peroxide decomposition uses catalysts<br>• used in catalytic converters<br>• use of enzymes as biological catalysts | (6)<br>AO1 |

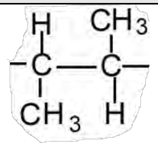
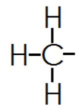
| Level | Mark | Additional Guidance | General additional guidance – the decision between levels |
|---|---|---|---|
| | 0 | No rewardable material. | Read whole answer and ignore all incorrect material/ discard any contradictory material then: |
| Level 1 | 1-2 | Additional Guidance<br>identifies a catalysed reaction<br>describes simply the role of a catalyst or labelling activation energy on the diagram | Possible Candidate Responses<br>• Haber process to make ammonia (uses iron catalyst)<br>• enzymes are catalysts<br>• a catalyst speeds up a reaction but does not get used up |
| Level 2 | 3-4 | Additional Guidance<br>Two from<br>identifies at least one catalysed reaction<br>gives a good description of the role of catalyst<br>describes the function of a catalyst OR draws a labelled reaction profile (or amends that on question) | Possible Candidate Responses<br>Two from:<br>• Haber process to make ammonia (uses iron catalyst) and cracking to make smaller alkanes<br>• a catalyst increases the rate of a reaction without affecting the products; the catalyst is chemically unchanged and its mass remains the same<br>• a catalyst provides an alternative route for a reaction in which the activation energy is lowered so a greater proportion of collisions lead to products<br>OR<br>provides a labelled reaction profile (or amended the one in the question |
| Level 3 | 5-6 | Additional Guidance<br>Identifies at least one catalysed reactions<br>AND<br>Gives a good description of the role of catalyst<br>AND<br>describes the function of a catalyst OR draws a labelled reaction profile (or amends that on question) | Possible Candidate Responses<br>• Haber process to make ammonia uses iron catalyst / cracking to make smaller alkanes<br>a catalyst increases the rate of a reaction without affecting the products; the catalyst is chemically unchanged and its mass remains the same<br>a catalyst provides an alternative route for a reaction in which the activation energy is lowered so a greater proportion of collisions lead to products<br>OR<br>provides a labelled reaction profile (or amended the one in the question |

| Level | Mark | Descriptor |
|---|---|---|
| | 0 | • No awardable content |
| Level 1 | 1-2 | • Demonstrates elements of chemical understanding, some of which is inaccurate. Understanding of scientific ideas lacks detail. (AO1)<br>• Deconstructs scientific information but understanding and connections are flawed. An unbalanced or incomplete argument that provides limited synthesis of understanding. (AO3) |
| Level 2 | 3-4 | • Demonstrates chemical understanding, which is mostly relevant but may include some inaccuracies. Understanding of scientific ideas is not fully detailed and/or developed. (AO1)<br>• Deconstructs scientific information and provides some logical connections between scientific concepts. An imbalanced argument that synthesises mostly relevant understanding, but not entirely coherently (AO3) |
| Level 3 | 5-6 | • Demonstrates accurate and relevant chemical understanding throughout. Understanding of the scientific ideas is detailed and fully developed. (AO1)<br>• Deconstructs scientific information and provide logical connections between scientific concepts throughout. A balanced, well-developed argument that synthesises relevant understanding coherently. (AO3) |

(Total for question 9 = 11 marks)

| Question number | Answer | Additional guidance | Mark |
|---|---|---|---|
| 10(a)(i) | but-2-ene | allow 2-butene | (1)<br>AO1 1 |

| Question number | Answer | Additional guidance | Mark |
|---|---|---|---|
| 10(a)(ii) | $C_4H_8 + Br_2 \rightarrow C_4H_8Br_2$<br><br>fully correct equation (2)<br><br>if equation not fully correct, then correct formula of product $C_4H_8Br_2$ (1) | reject charges on formulae<br>reject superscript numbers<br><br>allow incorrect lower and upper case letters | (2)<br>AO2 2 |

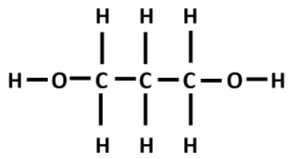
| Question number | Answer | Additional guidance | Mark |
|---|---|---|---|
| 10(a)(iii) | <br>2 neighbouring carbon atoms with single bond and continuation bonds shown (1)<br><br>rest of repeating unit correct (1) | allow<br><br>$CH_3$ or <br><br>ignore brackets and n<br>MP2 depends on MP1 | (2)<br>AO2 1 |

| Question number | Answer | Additional guidance | Mark |
|---|---|---|---|
| 10(b)(i) | propene | accept prop-1-ene / 1-propene | (1)<br>AO2 1 |

| Question number | Answer | Additional guidance | Mark |
|---|---|---|---|
| 10(b)(ii) | -COOH / COOH / | allow $CO_2H$<br>allow displayed formula | (1)<br>AO2 1 |

| Question number | Answer | Additional guidance | Mark |
|---|---|---|---|
| 10(b)(iii) | the polystyrene cup {is a poor conductor of heat / will melt / will burn} | ignore reference to any equipment other than the polystyrene cup (e.g. clamp stand) | (1)<br>AO1 2 |

| Question number | Answer | Mark |
|---|---|---|
| 10(c)(i) | $H_2O$ | (1)<br>AO1 1 |

| Question number | Answer | Additional guidance | Mark |
|---|---|---|---|
| 10(c)(ii) | <br>fully correct diagram scores (2)<br>if not scores (1) for 3 single bonded carbon atoms / 2 OH groups | allow OH or O-H<br><br>reject any double bonds | (2)<br>AO2 1 |

(Total for question 10 = 11 marks)