

Markscheme

May 2021








Chemistry








On-screen examination

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The following are the annotations available to use when marking responses.

| Annotation | Explanation |
|---|--|
|  | Correct point, place at the point in the response where it is clear that the candidate deserves the mark. For use in analytically marked questions only. |
|  | Omission, incomplete |
| CON | Contradiction |
|  | Valid part (to be used when more than one element is required to gain the mark) |
|  | Error carried forward |
|  | Dynamic annotation, it can be expanded to surround work |
|  | Horizontal wavy line that can be expanded |
|  | Highlight tool that can be expanded to mark an area of a response |

| Annotation | Explanation |
|---|--|
|  | Not good enough |
|  | The candidate has given a response but it is not worthy of any marks |
|  | Text box used for additional marking comments |
|  | Seen; must be stamped on all blank response areas and on duplicate pages of concatenated responses |
|  | Vertical wavy line that can be expanded |
|  | Words to that effect |
|  | Award 1, 2, 3, 4 marks. For use in holistically marked questions only |

Markscheme instructions

- 1 Mark positively. Give candidates credit for what they have achieved and what is correct. Do not deduct marks for incorrect responses.
- 2 Follow the markscheme provided and award only whole marks.
- 3 Each marking point appears on a separate line.
- 4 The maximum mark for each subpart is indicated in the “Total” column.
- 5 Where a mark is awarded a tick should be placed in the text at the precise point where it is clear the candidate deserves the mark.
- 6 Each marking point in a question part should be awarded separately unless there is an instruction to the contrary in the Notes column.
- 7 A question subpart may have more marking points than the total allows. This will be indicated by the word “**max**” in the Answer column. Further guidance may be given in the Notes column.
- 8 Additional instructions on how to interpret the markscheme are in bold italic text in the Answer column.
- 9 Alternative wording may be indicated in the Answer column by a slash (/). Either alternative is equally acceptable but the candidate cannot be rewarded for both as they are associated with the same marking point.
- 10 Alternative answers are indicated in the Answer column by “**or**”. Either alternative is equally acceptable but the candidate cannot be rewarded for both as they are associated with the same marking point.
- 11 If two related points are required to award a mark, this is indicated by “**and**” in the answer column.
- 12 Words in brackets () in the Answer column are not necessary to gain the mark.
- 13 Words that are underlined are essential for the mark.
- 14 In some questions a reverse argument is also acceptable. This is indicated by the abbreviation *ORA (or reverse argument)* in the Notes column. Candidates should not be rewarded for reverse arguments unless *ORA* is given in the Notes column.
- 15 If the candidate’s response has the same meaning or is clearly equivalent to the expected answer the mark should be awarded. In some questions this is emphasized by the abbreviation *WTTE (or words to that effect)* in the Notes column.
- 16 When incorrect answers are used correctly in subsequent question parts the follow through rule applies. Award the mark and add ECF (error carried forward) to the candidate response.
- 17 The order of marking points does not have to be the same as in the Answer column unless stated otherwise.
- 18 Marks should not be awarded where there is a contradiction in an answer. Add CON to the candidate response at the point where the contradiction is made.
- 19 Do not penalize candidates for errors in units or significant figures unless there is specific guidance in the Notes column.
- 20 Questions with higher mark allocations will generally be assessed using a level response method using task specific clarifications developed with reference to the criteria level descriptors. A candidate’s work should be reviewed to determine holistically the mark for each row of the holistic grid and a mark awarded for each row.

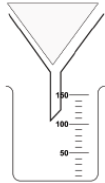

| Question | Answers | Notes | Total | Criterion | |
|----------|---------|---|---|-----------|---|
| 1 | a | Magnesium <input type="text" value="2 electrons"/> | | 1 | A |
| | b | Group 4 Period 3 | Allow 14, IVA | 2 | A |
| | c | <input type="text" value="Transition metals"/> | | 1 | A |
| | d | H atom has one electron (in outer shell so is electronically unstable) H atoms need to share electrons in order to gain stability or to obtain the electron configuration of a noble gas He (already) has a full outer shell of electrons or complete outer shell (so) there is no need for He to share electrons or does not react or does not bond or is already stable | Accept "stable electron shell", "noble gas configuration", "complete duplet" Do not accept "balanced". Ignore "octet" | 4 | A |
| | e | <input type="text" value="C"/> | | 1 | A |
| 2 | a | Mass number: number of protons + number of neutrons or $A = p^+ + n^0$ Mass number = 17 | Seen or implied No ECF from first marking point, award two marks for 17 alone Max 1 if g added | 2 | A |
| | b | Accept any reasonable response related to oxygen, for example [max 1] <ul style="list-style-type: none"> oxygen can be produced from decomposition of CO₂ depends on the amount of water that decomposes oxygen formed may not be enough for any kind of biological process to occur reference to O₂ being in organic molecules | Do not accept that oxygen is in water as this is in the question | 1 | A |

| | | | | |
|---|--|---|---|---|
| c | 46 | <i>Ignore units if present</i> | 1 | A |
| d | Top of the range = 7 Range expressed precisely between 4.3-4.5 to 7 | <i>Award two marks for correct answer</i> | 2 | A |
| e | The temperature is higher or there is more heat or more energy on the surface of exoplanets that are closer to the star they orbit (so) at higher temperatures the rate of the reaction increases | | 2 | A |
| f | Catalysts increase the rate of a reaction or speed up a reaction Any further additional point from the list [max 1] <ul style="list-style-type: none"> • reaction using a catalyst has a lower (activation) energy • reaction using a catalyst reduces (activation) energy • reaction using a catalyst takes place by an alternative path • the catalyst is not used up or consumed | | 2 | A |
| g | Accept any two reasonable suggestions, for example [max 2] <ul style="list-style-type: none"> • collect materials that may be useful on the Earth • collect materials that may give information about the origin of the structure or the atmosphere of the Moon or the universe • search for water • enable possible human settlement in the future • collect materials to look for signs of life • political control of the moon • the Moon could be used as a base for exploring other planets | | 2 | D |

| | | | | | |
|---|---|--|--|---|---|
| 3 | a | A: Solid ▾ B: Liquid ▾ | | 2 | A |
| | b | Pentane Alkane ▾ | <i>ECF for alkene if pentene was stated as the name of the hydrocarbon</i> | 2 | A |
| | c | <input type="text" value="1"/> C ₅ H ₁₂ (l) + <input type="text" value="8"/> O ₂ (g) → <input type="text" value="5"/> CO ₂ (g) + <input type="text" value="6"/> H ₂ O(g) Reactants correctly balanced Products correctly balanced | <i>Do not accept ? for pentane</i> | 2 | A |
| | d | Increase The wax or fuel will not move away from the wick (and so) will remain to allow the candle to burn for a longer time or Increase The metal will remove the heat (and so) the wax will not melt and be available to burn or Decrease The wax is contained (and so) it is available to burn | <i>Do not award the first marking point alone</i> <i>WTTE</i> <i>Or reference to wick will burn longer</i> | 3 | B |

| | | | | |
|---|---|---|---|---|
| e | 1.06 x 10 ⁻¹ (g min ⁻¹) | <i>Ignore unit</i> | 1 | D |
| f | <p>Accept any two points from the list [max 2]</p> <ul style="list-style-type: none"> • data plotted incorrectly • should show rate decreasing with height or a negative correlation • should be a scatter graph • it is continuous data • IV (altitude) should be on x axis or DV should be on y axis • number of decimal places • order of rates on the x axis • increments on the x axis | <i>Accept linear or line graph</i> | 2 | C |
| g | <p>Accept any two reasons from the list [max 2]</p> <ul style="list-style-type: none"> • different weather or location • different equipment • available oxygen or air composition <p>Correctly linked suggestion of how the result would be affected [max 2]</p> <ul style="list-style-type: none"> • effect of specific weather type or location correctly linked to rate • effect of different equipment correctly linked to rate • rate of combustion | <p><i>WTTE</i> <i>Different aspects of equipment can be credited twice</i> <i>Do not accept different type of wax</i></p> | 4 | C |

| | | | | | |
|---|---|--|--|---|---|
| 4 | a | Independent variable: fragrance Dependent variable: burn time | Accept "flavour", "ingredient" | 2 | B |
| | b | 30(.0 hours) 30.0 correctly expressed to 3 sig figs | Ignore any units ECF from first marking point for transcription error | 2 | C |
| | c | The second student did not include the outlier at 24.3 hours in their average calculation | WTTE | 1 | C |
| | d | Not valid because the strawberry has a longer time to burn Accept two any additional points from the list below [max 2] <ul style="list-style-type: none"> • different containers • different masses so no direct comparison • insufficient data to test the hypothesis • in first data set would need to repeat investigation due to the 24.3 hours • different wick sizes | Ignore references to surface area | 3 | C |
| | e | Use the same style or mass of container or candle This would give identical heat transfer characteristics or Additional trials and calculate averages Reduce random error or Use the same mass of wax Time how long the candles took to burn | Do not accept trials with different fragrances as this will not improve validity WTTE WTTE | 2 | C |

| | | | | | |
|----------|----------|--|--|----------|----------|
| <p>5</p> | <p>a</p> |  <p>Correct arrangement visible</p> <p>Only filter paper and beaker selected</p> | <p><i>The funnel is already provided to candidates so should not be counted as additional equipment</i></p> <p><i>Award second mark only if no other equipment is seen</i></p> | <p>2</p> | <p>B</p> |
| | <p>b</p> | <p><input type="button" value="C"/></p> | | <p>1</p> | <p>B</p> |
| | <p>c</p> |  <p>y axis scale with even increments</p> <p>y axis scale starting at zero</p> <p>All data correctly plotted</p> <p>A title linking IV with DV</p> <p>x axis: Type of fuel or biomass</p> <p>y axis: Energy / MJ Tonne⁻¹</p> | | <p>6</p> | <p>C</p> |

| | | | | |
|---|--|-------------|---|---|
| d | <input type="text" value="Exothermic"/> | | 1 | A |
| e | Reduces waste Reduced reliance on landfill or As a new fuel source Reduced reliance on fossil fuels or reduces waste or Used as fertiliser Reduced need for artificial fertilisers or reduces waste | <i>WTTE</i> | 2 | D |

| | | | | | | | |
|----------|------------------------|---|---|--|--|----|---|
| 6 | | 1 | 2 | 3 | 4 | 16 | B |
| | Variables | some variables implied | fuel type as IV or DV as <u>mass</u> or one CV identified | fuel type as IV and DV as <u>mass</u> and one CV identified | fuel type as IV and DV as <u>mass</u> and temperature change identified as a CV and one additional CV identified | | |
| | Justification | set up one selected and justification that the temp change can be measured or set up two selected with no justification | set up two selected and justification that the temp change can be measured and heat losses are minimized | | | | |
| | Sufficient data | reference to different fuels | all five fuels or three trials | all five fuels and three trials | all five fuels and three trials and calculates mean | | |
| | Method | attempt at method but may be not relevant | attempt at method, insufficient detail and temperature change is mentioned but method is not likely to give relevant data | method for measuring mass of fuel burned for fixed temp change or fixed time (<5 mins) is described, could be followed, will produce relevant data | complete method for measuring mass of fuel burned for fixed temp change or fixed time (<5 mins) for all fuels is fully explained and could be replicated | | |
| | Safety | a safety concern is mentioned | a safety concern is mentioned and linked to a specific hazard | | | | |

| 7 | a | Australia (and Oceania) | | | 1 | C | | | | | | | | | | | | | | | |
|---------------|---|--|---|---|---|---|---|---|---|------------------------------|--|---|---|---|---------------|------------------------|---|--|--|---|---|
| | b | 2150 +/-100 Billion and m ³ or cubic metres | | | 2 | C | | | | | | | | | | | | | | | |
| | c | Population increase | | | 1 | C | | | | | | | | | | | | | | | |
| | d | <div style="border: 1px solid black; padding: 2px; display: inline-block;">Pore size ▾</div> The pores of the filter need to be smaller than the material that is being separated out | | | 2 | D | | | | | | | | | | | | | | | |
| e | <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th></th> <th>1</th> <th>2</th> <th>3</th> <th>4</th> </tr> </thead> <tbody> <tr> <td>Advantages and disadvantages</td> <td>an advantage or disadvantage of CCU (ORA)</td> <td>an advantage and disadvantage of CCU (ORA)</td> <td>an advantage and disadvantage of CCU (ORA) with either supported by scientific reasoning</td> <td>an advantage and disadvantage of CCU (ORA) with both supported by scientific reasoning</td> </tr> <tr> <td>Justification</td> <td>a simple justification</td> <td>a simple justification with supporting evidence</td> <td></td> <td></td> </tr> </tbody> </table> | | | | | 1 | 2 | 3 | 4 | Advantages and disadvantages | an advantage or disadvantage of CCU (ORA) | an advantage and disadvantage of CCU (ORA) | an advantage and disadvantage of CCU (ORA) with either supported by scientific reasoning | an advantage and disadvantage of CCU (ORA) with both supported by scientific reasoning | Justification | a simple justification | a simple justification with supporting evidence | | | 6 | D |
| | | 1 | 2 | 3 | 4 | | | | | | | | | | | | | | | | |
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| Justification | a simple justification | a simple justification with supporting evidence | | | | | | | | | | | | | | | | | | | |
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|----------|------------------------------|--|--|--|--|----|---|--|
| 8 | | 1 | 2 | 3 | 4 | 13 | D | |
| | Economic comparison | a statement comparing two technologies | a statement comparing all three technologies <i>or</i> a statement comparing two technologies with supporting evidence | a statement comparing all three technologies with supporting evidence using data | | | | |
| | Environmental | one impact on the environment is implied | a statement of one impact on the environment for one technology | a statement of one impact on the environment of at least two technologies | a statement of one impact on the environment of all three technologies | | | |
| | Not suitable | one technology is supported with a reason (may be incorrect) | micro and ultrafiltration are not suitable as heavy metals are not removed | | | | | |
| | Social considerations | a statement of a social impact | a statement of a social impact with supporting evidence | | | | | |
| | Appraisal | a concluding appraisal | a concluding appraisal linking the issues discussed | | | | | |