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# **GCSE MARKING SCHEME**

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**SUMMER 2023**

**GCSE  
SCIENCE (DOUBLE AWARD) - UNIT 5**

**3430U50-1 AND 3430UE0-1**

## **INTRODUCTION**

This marking scheme was used by WJEC for the 2023 examination. It was finalised after detailed discussion at examiners' conferences by all the examiners involved in the assessment. The conference was held shortly after the paper was taken so that reference could be made to the full range of candidates' responses, with photocopied scripts forming the basis of discussion. The aim of the conference was to ensure that the marking scheme was interpreted and applied in the same way by all examiners.

It is hoped that this information will be of assistance to centres but it is recognised at the same time that, without the benefit of participation in the examiners' conference, teachers may have different views on certain matters of detail or interpretation.

WJEC regrets that it cannot enter into any discussion or correspondence about this marking scheme.

## GCSE SCIENCE (DOUBLE AWARD) UNIT 5 – CHEMISTRY 2

### SUMMER 2023 MARK SCHEME

#### GENERAL INSTRUCTIONS

##### Marking rules

All work should be seen to have been marked.

Marking schemes will indicate when explicit working is deemed to be a necessary part of a correct answer.

Crossed out responses not replaced should be marked.

Credit will be given for correct and relevant alternative responses which are not recorded in the mark scheme.

##### Extended response question

A level of response mark scheme is used. Before applying the mark scheme please read through the whole answer from start to finish. Firstly, decide which level descriptor matches best with the candidate's response: remember that you should be considering the overall quality of the response. Then decide which mark to award within the level. Award the higher mark in the level if there is a good match with both the content statements and the communication statements.

##### Marking abbreviations

The following may be used in marking schemes or in the marking of scripts to indicate reasons for the marks awarded.

|     |   |                       |
|-----|---|-----------------------|
| cao | = | correct answer only   |
| ecf | = | error carried forward |
| bod | = | benefit of doubt      |

### FOUNDATION TIER ONLY QUESTIONS

| Question |     |      |    | Marking details                                                                                                                                                                                                                                                                                                                                                                                        | Marks available |     |     |       |       |      |
|----------|-----|------|----|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|-----|-----|-------|-------|------|
|          |     |      |    |                                                                                                                                                                                                                                                                                                                                                                                                        | AO1             | AO2 | AO3 | Total | Maths | Prac |
| 1        | (a) | (i)  | I  | hydrogel                                                                                                                                                                                                                                                                                                                                                                                               | 1               |     |     | 1     |       |      |
|          |     |      | II | photochromic (pigment)                                                                                                                                                                                                                                                                                                                                                                                 | 1               |     |     | 1     |       |      |
|          |     | (ii) |    | <div> <div>heat it</div> <div>add water</div> <div>place it in sunlight</div> <div> <input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> </div> </div>                                                                                                                                                                                                                | 1               |     |     | 1     |       |      |
|          | (b) | (i)  |    | <div> <div>high melting point</div> <div>conducts electricity when dissolved or molten</div> <div> <div>ions are regularly arranged</div> <div>strong bonds between ions</div> <div>ions are free to move</div> <div>ions cannot move</div> <div>weak bonds between ions</div> </div> </div> <p>award (1) for each correct line<br/>do not credit if more than one line drawn from either property</p> | 2               |     |     | 2     |       |      |

| Question |     |      |  | Marking details                                                                                           | Marks available |          |          |          |          |          |
|----------|-----|------|--|-----------------------------------------------------------------------------------------------------------|-----------------|----------|----------|----------|----------|----------|
|          |     |      |  |                                                                                                           | AO1             | AO2      | AO3      | Total    | Maths    | Prac     |
|          |     | (ii) |  | <p>award (1) for each correct line<br/>do not credit if more than one line drawn from either property</p> | 2               |          |          | 2        |          |          |
|          | (c) |      |  | <p>hard (1)</p> <p>over (1)</p>                                                                           | 2               |          |          | 2        |          |          |
|          |     |      |  | <b>Question 1 total</b>                                                                                   | <b>9</b>        | <b>0</b> | <b>0</b> | <b>9</b> | <b>0</b> | <b>0</b> |

| Question |     |  |  | Marking details                                                                                                                                                                                                                                                                                                                  | Marks available |     |     |       |       |      |
|----------|-----|--|--|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|-----|-----|-------|-------|------|
|          |     |  |  |                                                                                                                                                                                                                                                                                                                                  | AO1             | AO2 | AO3 | Total | Maths | Prac |
| 2        | (a) |  |  | limestone (1)<br><br>(hot) air (1)                                                                                                                                                                                                                                                                                               | 2               |     |     | 2     |       |      |
|          | (b) |  |  | $\text{Fe}_2\text{O}_3 + 3\text{CO} \rightarrow 2\text{Fe} + 3\text{CO}_2$                                                                                                                                                                                                                                                       |                 | 1   |     | 1     |       |      |
|          | (c) |  |  | <div>40 + 28 + 16 <input type="checkbox"/></div> <div>40 + 40 + 40 + 28 + 28 + 28 + 16 + 16 + 16 <input type="checkbox"/></div> <div>40 + 28 + 16 + 16 + 16 <input checked="" type="checkbox"/></div> <div>40 + 16 + 16 + 16 <input type="checkbox"/></div> <div>40 + 28 + 28 + 28 + 16 + 16 + 16 <input type="checkbox"/></div> |                 | 1   |     | 1     |       |      |
|          | (d) |  |  | 46.9 (2)<br><br>if answer incorrect award (1) for any of following<br><br>$\frac{820}{1750}$<br><br>0.46857147 / 0.5 / 46.857147 / 46.86 / 46.8 / 46 / 47                                                                                                                                                                        |                 | 2   |     | 2     | 2     |      |
|          |     |  |  | Question 2 total                                                                                                                                                                                                                                                                                                                 | 2               | 4   | 0   | 6     | 2     | 0    |

| Question |     |      |  | Marking details                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Marks available |     |     |       |       |      |
|----------|-----|------|--|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|-----|-----|-------|-------|------|
|          |     |      |  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | AO1             | AO2 | AO3 | Total | Maths | Prac |
| 3        | (a) | (i)  |  | same concentration / strength (1)<br>same temperature (1)<br>neutral answer - reference to volume or amount of acid                                                                                                                                                                                                                                                                                                                                                                                      | 2               |     |     | 2     |       | 2    |
|          |     | (ii) |  | <b>B</b><br><b>A</b><br><b>D</b><br><b>C</b> order correct (1)<br>award (1) for any of following<br>the more reactive (the metal) the more bubbles / fizzing<br>the less reactive (the metal) the less bubbles / fizzing<br>the most reactive (metal) has the most bubbles / fizzing<br>the least reactive (metal) has the least bubbles / fizzing<br>accept reference to <b>B</b> having the <u>most</u> bubbles or <b>C</b> having <u>no bubbles</u> / the <u>least</u> bubbles if correct order given |                 | 2   |     | 2     |       | 2    |

| Question |     |      |     | Marking details                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Marks available |     |     |       |       |      |
|----------|-----|------|-----|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|-----|-----|-------|-------|------|
|          |     |      |     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | AO1             | AO2 | AO3 | Total | Maths | Prac |
|          | (b) | (i)  |     | thermometer is not in the acid / solution / in the air (1)<br><br>award (1) for any of following<br><br>will not measure the <u>temperature</u> of the reaction mixture / acid / solution<br>will measure the <u>temperature</u> of the air<br>will not get a <u>temperature</u> rise / change<br><u>temperature</u> will be lower than expected<br><u>temperature</u> recording will be incorrect<br><br>neutral answers<br>unreliable / inaccurate results<br>thermometer gives wrong reading<br>different temperature |                 |     | 2   | 2     |       | 2    |
|          |     | (ii) | I   | metal <b>D</b> test <b>2</b> <b>both</b> needed<br><br>accept correct answer circled in table                                                                                                                                                                                                                                                                                                                                                                                                                            |                 | 1   |     | 1     |       | 1    |
|          |     |      | II  | 23<br><br>accept 22 / 24<br><br>accept correct answer written in table                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                 | 1   |     | 1     | 1     | 1    |
|          |     |      | III | accept any value in the range 14.1 to 21.9<br>accept any range that falls within this range e.g. 15-21                                                                                                                                                                                                                                                                                                                                                                                                                   |                 |     | 1   | 1     | 1     |      |

| Question |     |      |  | Marking details                                                                                                                                                      | Marks available |          |          |           |          |          |
|----------|-----|------|--|----------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|----------|----------|-----------|----------|----------|
|          |     |      |  |                                                                                                                                                                      | AO1             | AO2      | AO3      | Total     | Maths    | Prac     |
|          | (c) | (i)  |  | $\text{Mg} + \boxed{2} \text{HCl} \longrightarrow \text{MgCl}_2 + \text{H}_2$ <p>award (1) for formula</p> <p>award (1) for balancing only if formula is correct</p> |                 | 2        |          | 2         |          |          |
|          |     | (ii) |  | <p>magnesium nitrate                      accept <math>\text{Mg}(\text{NO}_3)_2</math></p>                                                                           |                 | 1        |          | 1         |          |          |
|          |     |      |  | <b>Question 3 total</b>                                                                                                                                              | <b>2</b>        | <b>7</b> | <b>3</b> | <b>12</b> | <b>2</b> | <b>8</b> |

| Question |     |  |  | Marking details                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Marks available |     |     |       |       |      |
|----------|-----|--|--|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|-----|-----|-------|-------|------|
|          |     |  |  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | AO1             | AO2 | AO3 | Total | Maths | Prac |
| 4        | (a) |  |  | the <i>s</i> -block, <i>p</i> -block and <i>d</i> -block <input checked="" type="checkbox"/><br>the <i>s</i> -block and <i>p</i> -block only <input type="checkbox"/><br>the <i>s</i> -block only <input type="checkbox"/><br>the <i>d</i> -block and <i>p</i> -block only <input type="checkbox"/><br>the <i>p</i> -block only <input type="checkbox"/>                                                                                                                                                                                                                                                                             | 1               |     |     | 1     |       |      |
|          | (b) |  |  | titanium / Ti                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                 |     | 1   | 1     | 1     |      |
|          | (c) |  |  | the Group 1 metals and transition metals all have a +1 oxidation state <input type="checkbox"/><br>the transition metals all have a +3 oxidation state <input checked="" type="checkbox"/><br>the Group 1 metals all have a +1 oxidation state <input checked="" type="checkbox"/><br>iron and lithium have the same oxidation states <input type="checkbox"/><br>the Group 1 metals and transition metals all have a +4 oxidation state <input type="checkbox"/><br><br>award (1) for each correct tick<br><br>if more than two ticks<br>award (1) for two correct and one incorrect<br>award (0) for one correct and two incorrect |                 |     | 2   | 2     |       |      |

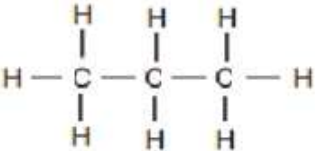
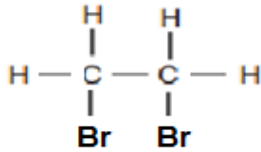
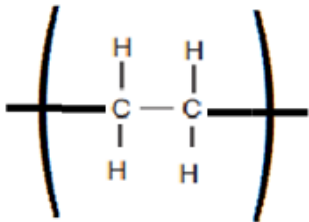
| Question |     |  |  | Marking details                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Marks available |          |          |          |          |          |
|----------|-----|--|--|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|----------|----------|----------|----------|----------|
|          |     |  |  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | AO1             | AO2      | AO3      | Total    | Maths    | Prac     |
|          | (d) |  |  | <p>agree – award (1) for either of following</p> <ul style="list-style-type: none"> <li>if the compound is coloured it must be a transition metal the transition metals have coloured compounds (whereas the Group 1 metals do not)</li> <li>accept 'Group 1 metal compounds are white'</li> </ul> <p>assume that coloured means not white</p> <p>disagree – award (1) for any of following</p> <ul style="list-style-type: none"> <li>titanium has a white compound but is not a Group 1 metal</li> <li>titanium <u>also</u> has a white compound</li> <li>just because the compound is white does not mean it is in Group 1</li> </ul> <p>neutral answer – some of the transition metal compounds are white</p> |                 |          | 2        | 2        |          |          |
|          |     |  |  | <b>Question 4 total</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | <b>1</b>        | <b>0</b> | <b>5</b> | <b>6</b> | <b>1</b> | <b>0</b> |

| Question |     |      |  | Marking details                                                                                                                                                                                                 | Marks available |     |     |       |       |      |
|----------|-----|------|--|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|-----|-----|-------|-------|------|
|          |     |      |  |                                                                                                                                                                                                                 | AO1             | AO2 | AO3 | Total | Maths | Prac |
| 5        | (a) | (i)  |  | <div> <div>F</div> →  <div>B</div> →  <div>E</div> →  <div>A</div> →  <div>D</div> →  <div>c</div> </div> <p>award (2) for all stages in correct order</p> <p>award (1) for stage <b>B</b> in correct place</p> | 2               |     |     | 2     |       | 2    |
|          |     | (ii) |  | <p><b>E</b> (1)</p> <p>likely to overshoot the end-point / add too much acid / go past the point of neutralisation / miss colour change (1)</p>                                                                 | 2               |     |     | 2     |       | 2    |
|          | (b) | (i)  |  | sulfuric acid                  accept H <sub>2</sub> SO <sub>4</sub>                                                                                                                                            |                 | 1   |     | 1     |       |      |
|          |     | (ii) |  | K <sub>2</sub> SO <sub>4</sub>                                                                                                                                                                                  |                 | 1   |     | 1     |       |      |
|          |     |      |  | Question 5 total                                                                                                                                                                                                | 4               | 2   | 0   | 6     | 0     | 4    |

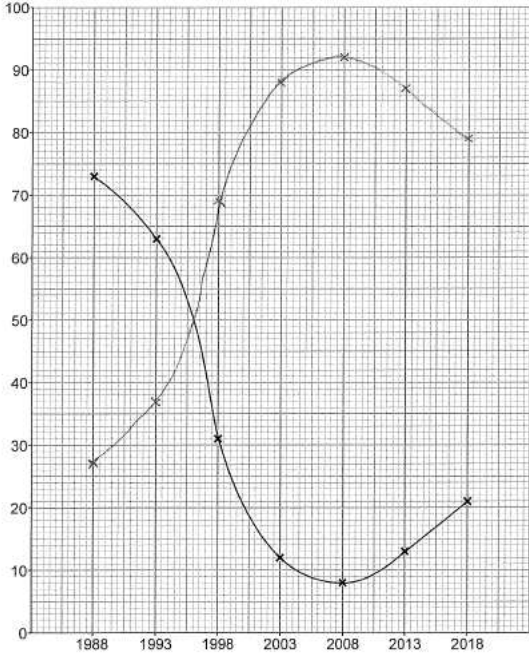
| Question |  |  |  | Marking details                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | Marks available |     |     |       |       |      |
|----------|--|--|--|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|-----|-----|-------|-------|------|
|          |  |  |  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | AO1             | AO2 | AO3 | Total | Maths | Prac |
| 6        |  |  |  | <p><b>Indicative content</b></p> <p><b>AO1</b></p> <ul style="list-style-type: none"> <li>• use of aluminium in aircraft / overhead power cables / saucepans / window frames</li> <li>• use of copper in electrical wires / saucepans / coins / jewellery</li> <li>• use of titanium in replacement joints / helicopter rotor blades / car parts</li> </ul> <p><b>AO2</b></p> <ul style="list-style-type: none"> <li>• uses of the metals linked to the properties in the table e.g. <ul style="list-style-type: none"> <li>➤ aluminium used in aircraft because of low density and good resistance to corrosion</li> <li>➤ copper used in saucepans because of high melting point and good thermal conductivity</li> <li>➤ titanium used in replacement joints because of low density and good resistance to corrosion</li> </ul> </li> </ul> <p><b>5-6 marks</b><br/> At least one use for each of the metals linked to two properties from the table; no reference made to other properties e.g. strength (AO3 marks)<br/> <i>There is a sustained line of reasoning which is coherent, relevant, substantiated and logically structured. The candidate uses appropriate scientific terminology and accurate spelling, punctuation and grammar.</i></p> | 2               | 2   | 2   | 6     |       |      |

| Question |  |  |  | Marking details                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Marks available |          |          |          |          |          |
|----------|--|--|--|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|----------|----------|----------|----------|----------|
|          |  |  |  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | AO1             | AO2      | AO3      | Total    | Maths    | Prac     |
|          |  |  |  | <p><b>3-4 marks</b><br/>One use for two of the metals linked to at least one property from the table<br/><i>There is a line of reasoning which is partially coherent, largely relevant, supported by some evidence and with some structure. The candidate uses mainly appropriate scientific terminology and some accurate spelling, punctuation and grammar.</i></p> <p><b>1-2 marks</b><br/>One use for two of the metals without links to properties from the table<br/><i>There is a basic line of reasoning which is not coherent, largely irrelevant, supported by limited evidence and with very little structure. The candidate uses limited scientific terminology and inaccuracies in spelling, punctuation and grammar.</i></p> <p><b>0 marks</b><br/><i>No attempt made or answer worthy or any credit.</i></p> |                 |          |          |          |          |          |
|          |  |  |  | <b>Question 6 total</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | <b>2</b>        | <b>2</b> | <b>2</b> | <b>6</b> | <b>0</b> | <b>0</b> |

### COMMON QUESTIONS

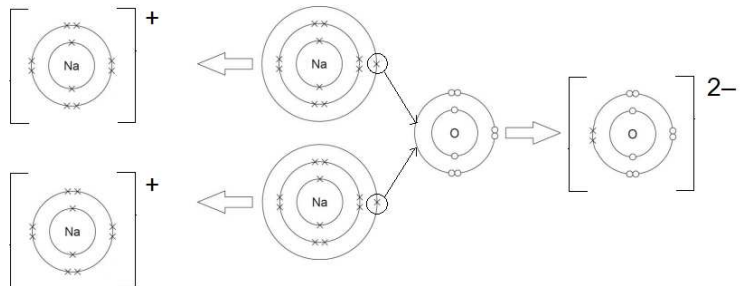
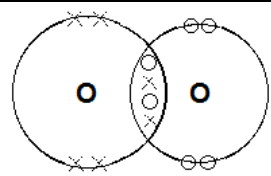
| Question |     |       |  | Marking details                                                                                                                                                                                                                                     | Marks available |     |     |       |       |      |
|----------|-----|-------|--|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|-----|-----|-------|-------|------|
|          |     |       |  |                                                                                                                                                                                                                                                     | AO1             | AO2 | AO3 | Total | Maths | Prac |
| 7/1      | (a) | (i)   |  | <b>D and E</b> both needed, either order                                                                                                                                                                                                            |                 | 1   |     | 1     |       |      |
|          |     | (ii)  |  | propene                                                                                                                                                                                                                                             | 1               |     |     | 1     |       |      |
|          |     | (iii) |  |                                                                                                                                                                    | 1               |     |     | 1     |       |      |
|          | (b) | (i)   |  |  <p style="text-align: right;">(1)</p><br> <p style="text-align: right;">(1)</p> |                 | 2   |     | 2     |       |      |
|          |     | (ii)  |  | decolourises / goes colourless<br>neutral answers – goes clear / changes colour                                                                                                                                                                     | 1               |     |     | 1     |       | 1    |

| Question |     |       |  | Marking details                                                                                                                       | Marks available |     |     |       |       |      |
|----------|-----|-------|--|---------------------------------------------------------------------------------------------------------------------------------------|-----------------|-----|-----|-------|-------|------|
|          |     |       |  |                                                                                                                                       | AO1             | AO2 | AO3 | Total | Maths | Prac |
|          |     | (iii) |  | (addition) polymerisation                                                                                                             | 1               |     |     | 1     |       |      |
|          | (c) | (i)   |  | 0.15 (2)<br>if answer incorrect award (1) for any of following<br>$\frac{12}{100} \times 1.25$<br>$0.0125 \times 12$<br>$15 / 150000$ |                 | 2   |     | 2     | 2     |      |

| Question |  |      |  | Marking details                                                                                                                                                                                                                                                                                                   | Marks available |     |     |       |       |      |
|----------|--|------|--|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|-----|-----|-------|-------|------|
|          |  |      |  |                                                                                                                                                                                                                                                                                                                   | AO1             | AO2 | AO3 | Total | Maths | Prac |
|          |  | (ii) |  |  <p>award (2) for <b>all</b> points plotted correctly – tolerance <math>\pm 1</math> square</p> <p>award (1) for any <b>four</b> correct points</p> <p>award (1) for curved line</p> <p>do not accept - point to point line</p> |                 | 3   |     | 3     | 3     |      |

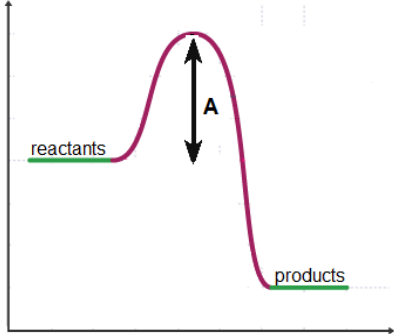
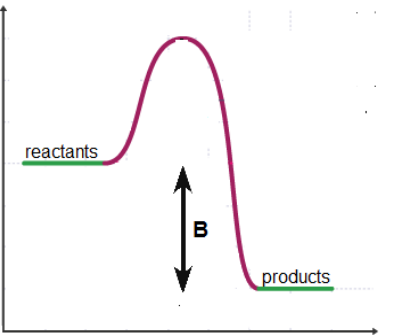
| Question |  |       |    | Marking details                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Marks available |     |     |       |       |      |
|----------|--|-------|----|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|-----|-----|-------|-------|------|
|          |  |       |    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | AO1             | AO2 | AO3 | Total | Maths | Prac |
|          |  | (iii) | I  | 1996<br><br>accept 1995 / 1997<br>accept range 1995-1996 / 1996-1997                                                                                                                                                                                                                                                                                                                                                                                                                             |                 | 1   |     | 1     |       | 1    |
|          |  |       | II | 2 : 8    1 : 4    4 : 1    8 : 2    20 : 80                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                 |     | 1   | 1     | 1     |      |
|          |  | (iv)  |    | award (1) for any of following actions<br><br>people <b>use</b> bag for life / alternative bags<br>people <b>reuse</b> bags<br>supermarkets <b>charge</b> for bags / <b>stop giving</b> free plastic bags<br>government <b>introduced</b> a charge<br>people have <b>become more aware</b> of issues to do with plastic waste<br>people <b>want to reduce</b> amount of plastic going to landfill / incineration<br>people <b>want to reduce</b> the amount of plastic pollution / microplastics |                 |     | 1   | 1     |       |      |
|          |  |       |    | Question 7/1 total                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 4               | 9   | 2   | 15    | 6     | 2    |

# HIGHER TIER ONLY QUESTIONS

| Question |     |      |  | Marking details                                                                                                                                                                                                                                                                                                                 | Marks available |     |     |       |       |      |
|----------|-----|------|--|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|-----|-----|-------|-------|------|
|          |     |      |  |                                                                                                                                                                                                                                                                                                                                 | AO1             | AO2 | AO3 | Total | Maths | Prac |
| 2        | (a) | (i)  |  |  <p>outer shell electron of both sodium atoms shown going to the outer shell of the oxygen atom (1)</p> <p>correct charges on <b>both</b> sodium ions <u>and</u> the oxide ion (1)</p>                                                        |                 | 2   |     | 2     |       |      |
|          |     | (ii) |  |  <p>award (2) for correct diagram with <b>two</b> shared pairs of electrons in the overlap <u>and</u> correct octet for both atoms</p> <p>if incorrect award (1) for overlapping oxygen atoms with <b>two</b> shared pairs in the overlap</p> |                 | 2   |     | 2     |       |      |

| Question |     |      |    | Marking details                                                                    | Marks available |          |          |          |          |          |
|----------|-----|------|----|------------------------------------------------------------------------------------|-----------------|----------|----------|----------|----------|----------|
|          |     |      |    |                                                                                    | AO1             | AO2      | AO3      | Total    | Maths    | Prac     |
|          | (b) | (i)  | I  | graphite – (because it has) free/mobile/delocalised electrons (between the layers) | 1               |          |          | 1        |          |          |
|          |     |      | II | graphite – (because) the layers can slide over each other                          | 1               |          |          | 1        |          |          |
|          |     | (ii) |    | nanotubes / graphene / fullerene / buckminsterfullerene<br>accept 'bucky ball'     | 1               |          |          | 1        |          |          |
|          |     |      |    | <b>Question 2 total</b>                                                            | <b>3</b>        | <b>4</b> | <b>0</b> | <b>7</b> | <b>0</b> | <b>0</b> |

| Question |     |      |  | Marking details                                                                                                                                                                                                                                             | Marks available |     |     |       |       |      |
|----------|-----|------|--|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|-----|-----|-------|-------|------|
|          |     |      |  |                                                                                                                                                                                                                                                             | AO1             | AO2 | AO3 | Total | Maths | Prac |
| 3        | (a) | (i)  |  | 498 (3)<br>if answer incorrect award credit for each correct step<br>$(2 \times \text{C—C}) + (8 \times \text{C—H}) / 4000 / 696 + 3304$ (1)<br>$(5 \times \text{O=O}) = 6490 - 4000 / 2490$ (1)<br>$\text{O=O} = \frac{2490}{5} = 498$ (1)<br>ecf possible |                 | 3   |     | 3     | 3     |      |
|          |     | (ii) |  | 2052 kJ taken in <input type="checkbox"/><br>15032 kJ taken in <input type="checkbox"/><br>15032 kJ given out <input type="checkbox"/><br>2052 kJ given out <input checked="" type="checkbox"/>                                                             |                 |     | 1   | 1     | 1     |      |
|          | (b) |      |  | 70 / 69.8 / 69.84<br>do not accept 69.9                                                                                                                                                                                                                     | 1               |     |     | 1     | 1     |      |

| Question |     |      |  | Marking details                                                                                                                 | Marks available |     |     |       |       |      |
|----------|-----|------|--|---------------------------------------------------------------------------------------------------------------------------------|-----------------|-----|-----|-------|-------|------|
|          |     |      |  |                                                                                                                                 | AO1             | AO2 | AO3 | Total | Maths | Prac |
|          | (c) | (i)  |  |  <p><b>must</b> be unambiguously labelled</p>  | 1               |     |     | 1     |       |      |
|          |     | (ii) |  |  <p><b>must</b> be unambiguously labelled</p> | 1               |     |     | 1     |       |      |
|          |     |      |  | Question 3 total                                                                                                                | 3               | 3   | 1   | 7     | 5     | 0    |

| Question |     |     |  | Marking details                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Marks available |     |     |       |       |      |
|----------|-----|-----|--|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|-----|-----|-------|-------|------|
|          |     |     |  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | AO1             | AO2 | AO3 | Total | Maths | Prac |
| 4        | (a) |     |  | burns and produces heat / acts as a fuel (1)<br>forms carbon monoxide (1)<br>carbon monoxide reduces the iron oxide / is a reducing agent (1)<br>award last marking point for coke as a reducing agent if no reference to carbon monoxide                                                                                                                                                                                                                                                                                                                                                                                                                                   | 3               |     |     | 3     |       |      |
|          | (b) | (i) |  | 100g of $\text{CaCO}_3$ can produce 56g of $\text{CaO}$ (1)<br>8g $\text{CaCO}_3$ can produce $\frac{56}{12.5}$ g of $\text{CaO}$ or 4.48g of $\text{CaO}$ (1)<br>award (1) for any of following<br>4.48 to one decimal place is 4.5 therefore Charlie is correct<br>4.48 to one decimal place is 4.5<br>4.48 therefore Charlie is correct<br>do not accept 4.5 and Charlie with <b>no working</b><br>alternative methods<br>0.08 mol $\text{CaCO}_3$ (1)<br>0.08 × 56 = 4.48g $\text{CaO}$ (1)<br>award (1) for any of following<br>4.48 to one decimal place is 4.5 therefore Charlie is correct<br>4.48 to one decimal place is 4.5<br>4.48 therefore Charlie is correct |                 |     | 3   | 3     | 3     | 3    |

| Question |     |      |  | Marking details                                                                                                                                                                                                                                                                                                                                                                      | Marks available |          |          |          |          |          |
|----------|-----|------|--|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|----------|----------|----------|----------|----------|
|          |     |      |  |                                                                                                                                                                                                                                                                                                                                                                                      | AO1             | AO2      | AO3      | Total    | Maths    | Prac     |
|          |     |      |  | 'trial and error' methods working backwards from any of the values given<br><br>e.g.<br>$\frac{4.4 \times 100}{56} = 7.86$<br>$\frac{4.5 \times 100}{56} = 8.04$ closest to 8.0g therefore Charlie<br>$\frac{5.0 \times 100}{56} = 8.93$<br>$\frac{100}{8} = 12.5$<br>$12.5 \times 4.4 = 55$<br>$12.5 \times 4.5 = 56.3$ closest to 56 therefore Charlie<br>$12.5 \times 5.0 = 62.5$ |                 |          |          |          |          |          |
|          |     | (ii) |  | CaSiO <sub>3</sub>                                                                                                                                                                                                                                                                                                                                                                   |                 | 1        |          | 1        |          |          |
|          | (c) |      |  | $\boxed{4} \text{ Fe} + 3\text{O}_2 \longrightarrow \boxed{2} \text{ Fe}_2\text{O}_3$<br><br>award (1) for formula<br><br>award (1) for balancing only if formula is correct                                                                                                                                                                                                         |                 | 2        |          | 2        |          |          |
|          |     |      |  | <b>Question 4 total</b>                                                                                                                                                                                                                                                                                                                                                              | <b>3</b>        | <b>3</b> | <b>3</b> | <b>9</b> | <b>3</b> | <b>3</b> |

| Question |     |       |  | Marking details                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Marks available |     |     |       |       |      |
|----------|-----|-------|--|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|-----|-----|-------|-------|------|
|          |     |       |  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | AO1             | AO2 | AO3 | Total | Maths | Prac |
| 5        | (a) | (i)   |  | award (1) <b>each</b> for <b>A</b> and <b>B</b><br><br><b>A</b> copper(II) nitrate / copper nitrate / $\text{Cu}(\text{NO}_3)_2$<br><b>B</b> carbon dioxide / $\text{CO}_2$<br><br>award (1) for <b>both C</b> and <b>D</b><br><b>C</b> zinc nitrate / $\text{Zn}(\text{NO}_3)_2$<br><b>D</b> copper                                                                                                                                                                                                   | 3               |     |     | 3     |       | 3    |
|          |     | (ii)  |  | $\text{Mg} + 2\text{HNO}_3 \rightarrow \text{Mg}(\text{NO}_3)_2 + \text{H}_2$<br><br>award (1) <b>each</b> for formulae of <u>products</u><br><br>award (1) for balancing only if all formulae are correct                                                                                                                                                                                                                                                                                             |                 | 3   |     | 3     |       |      |
|          |     | (iii) |  | displacement                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 1               |     |     | 1     |       | 1    |
|          | (b) | (i)   |  | $\text{H}^+ + \text{Cl}^- \longrightarrow \text{HCl}$ <input type="checkbox"/><br><br>$\text{Ba}^{2+} + \text{SO}_4^{2-} \longrightarrow \text{BaSO}_4$ <input checked="" type="checkbox"/><br><br>$\text{Ba}^{2+} + \text{S}^{2-} + 4\text{O}^{2-} \longrightarrow \text{BaSO}_4$ <input type="checkbox"/><br><br>$2\text{H}^+ + 2\text{Cl}^- \longrightarrow 2\text{HCl}$ <input type="checkbox"/><br><br>$\text{Ba}^{2+} + \text{SO}_4^{2-} \longrightarrow \text{BaSO}_4$ <input type="checkbox"/> |                 |     | 1   | 1     |       |      |

| Question |  |      |    | Marking details                                      | Marks available |          |          |           |          |          |
|----------|--|------|----|------------------------------------------------------|-----------------|----------|----------|-----------|----------|----------|
|          |  |      |    |                                                      | AO1             | AO2      | AO3      | Total     | Maths    | Prac     |
|          |  | (ii) | I  | flame test – (apple) green (flame)                   | 1               |          |          | 1         |          | 1        |
|          |  |      | II | silver nitrate (solution) – white <b>precipitate</b> | 1               |          |          | 1         |          | 1        |
|          |  |      |    | <b>Question 5 total</b>                              | <b>6</b>        | <b>3</b> | <b>1</b> | <b>10</b> | <b>0</b> | <b>6</b> |

| Question |     |  |  | Marking details                                                                                                                                                                                                                                                                                                                                                                 | Marks available |     |     |       |       |      |
|----------|-----|--|--|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|-----|-----|-------|-------|------|
|          |     |  |  |                                                                                                                                                                                                                                                                                                                                                                                 | AO1             | AO2 | AO3 | Total | Maths | Prac |
| 6        | (a) |  |  | <div>they are macromolecules <input type="checkbox"/></div> <div>they are unsaturated <input checked="" type="checkbox"/></div> <div>they contain hydrophilic groups <input type="checkbox"/></div> <div>they are polymers <input type="checkbox"/></div>                                                                                                                       |                 |     | 1   | 1     |       |      |
|          | (b) |  |  | ability to swell and shrink, depending on their surroundings                                                                                                                                                                                                                                                                                                                    |                 |     | 1   | 1     |       |      |
|          | (c) |  |  | 12440 (2)<br>if answer incorrect award (1) for<br>$4.389 - 0.035 = 4.354$                                                                                                                                                                                                                                                                                                       |                 | 2   |     | 2     | 2     |      |
|          | (d) |  |  | award (1) for <b>either</b> of following <ul style="list-style-type: none"> <li>the higher the temperature, the more the diameter increases (over time)</li> <li>the higher the temperature, the higher the rate of increase in diameter / the more quickly the diameter increases</li> </ul> at 40°C the size of the bead stops increasing / reaches maximum after 8 hours (1) |                 |     | 2   | 2     |       |      |
|          |     |  |  | Question 6 total                                                                                                                                                                                                                                                                                                                                                                | 0               | 2   | 4   | 6     | 2     | 0    |

| Question |  |  |  | Marking details                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Marks available |     |     |       |       |      |
|----------|--|--|--|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|-----|-----|-------|-------|------|
|          |  |  |  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | AO1             | AO2 | AO3 | Total | Maths | Prac |
| 7        |  |  |  | <p><b>Indicative content</b></p> <ul style="list-style-type: none"> <li>ions are free to move because aluminium oxide is molten</li> <li>ions travel to the oppositely charged electrodes because opposite charges attract / <math>\text{Al}^{3+}</math> ions go to the cathode / <math>\text{O}^{2-}</math> ions go to the anode</li> <li>reduction is gain of electrons, oxidation is loss of electrons</li> </ul> <p>at the cathode – reduction</p> <ul style="list-style-type: none"> <li><math>\text{Al}^{3+} + 3\text{e}^- \rightarrow \text{Al}</math></li> <li>aluminium ions gain 3 electrons to form aluminium atoms</li> </ul> <p>at the anode – oxidation</p> <ul style="list-style-type: none"> <li><math>2\text{O}^{2-} \rightarrow \text{O}_2 + 4\text{e}^-</math></li> <li>two oxide ions lose 2 electrons each to form two oxygen atoms</li> <li>these pair up to form oxygen molecules</li> </ul> <p><b>5-6 marks</b><br/>           Good explanation of the movement of ions towards both electrodes and of reduction and oxidation of both ions in terms of gain/loss of electrons; attempt at electrode equations<br/> <i>There is a sustained line of reasoning which is coherent, relevant, substantiated and logically structured. The candidate uses appropriate scientific terminology and accurate spelling, punctuation and grammar.</i></p> | 6               |     |     | 6     |       |      |

| Question |  |  |  | Marking details                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Marks available |     |     |       |       |      |
|----------|--|--|--|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|-----|-----|-------|-------|------|
|          |  |  |  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | AO1             | AO2 | AO3 | Total | Maths | Prac |
|          |  |  |  | <p><b>3-4 marks</b><br/>Attempt at explanation of the movement of ions and of reduction and oxidation in terms of gain/loss of electrons<br/><i>There is a line of reasoning which is partially coherent, largely relevant, supported by some evidence and with some structure. The candidate uses mainly appropriate scientific terminology and some accurate spelling, punctuation and grammar.</i></p> <p><b>1-2 marks</b><br/>Simple description of the movement of ions during the process; knowledge of reduction or oxidation in terms of gain/loss of electrons<br/><i>There is a basic line of reasoning which is not coherent, largely irrelevant, supported by limited evidence and with very little structure. The candidate uses limited scientific terminology and inaccuracies in spelling, punctuation and grammar.</i></p> <p><b>0 marks</b><br/><i>No attempt made or no response worthy of credit.</i></p> |                 |     |     |       |       |      |
|          |  |  |  | Question 7 total                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | 6               | 0   | 0   | 6     | 0     | 0    |

**FOUNDATION TIER****SUMMARY OF MARKS ALLOCATED TO ASSESSMENT OBJECTIVES**

| <b>Question</b> | <b>AO1</b> | <b>AO2</b> | <b>AO3</b> | <b>TOTAL MARK</b> | <b>MATHS</b> | <b>PRAC</b> |
|-----------------|------------|------------|------------|-------------------|--------------|-------------|
| <b>1</b>        | <b>9</b>   | <b>0</b>   | <b>0</b>   | <b>9</b>          | <b>0</b>     | <b>0</b>    |
| <b>2</b>        | <b>2</b>   | <b>4</b>   | <b>0</b>   | <b>6</b>          | <b>2</b>     | <b>0</b>    |
| <b>3</b>        | <b>2</b>   | <b>7</b>   | <b>3</b>   | <b>12</b>         | <b>2</b>     | <b>8</b>    |
| <b>4</b>        | <b>1</b>   | <b>0</b>   | <b>5</b>   | <b>6</b>          | <b>1</b>     | <b>0</b>    |
| <b>5</b>        | <b>4</b>   | <b>2</b>   | <b>0</b>   | <b>6</b>          | <b>0</b>     | <b>4</b>    |
| <b>6</b>        | <b>2</b>   | <b>2</b>   | <b>2</b>   | <b>6</b>          | <b>0</b>     | <b>0</b>    |
| <b>7</b>        | <b>4</b>   | <b>9</b>   | <b>2</b>   | <b>15</b>         | <b>6</b>     | <b>2</b>    |
| <b>TOTAL</b>    | <b>24</b>  | <b>24</b>  | <b>12</b>  | <b>60</b>         | <b>11</b>    | <b>14</b>   |

## HIGHER TIER

### SUMMARY OF MARKS ALLOCATED TO ASSESSMENT OBJECTIVES

| Question | AO1 | AO2 | AO3 | TOTAL MARK | MATHS | PRAC |
|----------|-----|-----|-----|------------|-------|------|
| 1        | 4   | 9   | 2   | 15         | 6     | 2    |
| 2        | 3   | 4   | 0   | 7          | 0     | 0    |
| 3        | 3   | 3   | 1   | 7          | 5     | 0    |
| 4        | 3   | 3   | 3   | 9          | 3     | 3    |
| 5        | 6   | 3   | 1   | 10         | 0     | 6    |
| 6        | 0   | 2   | 4   | 6          | 2     | 0    |
| 7        | 6   | 0   | 0   | 6          | 0     | 0    |
| TOTAL    | 25  | 24  | 11  | 60         | 16    | 11   |