

**GCSE (9–1)**

**Chemistry B (Twenty First Century Science)**

**J258/03: Breadth in Chemistry (Higher Tier)**

General Certificate of Secondary Education

**Mark Scheme for November 2020**

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

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

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

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Annotations available in RM Assessor

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

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

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

## 2. Subject-specific Marking Instructions

### INTRODUCTION

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

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

You should ensure that you have copies of these materials.

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

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

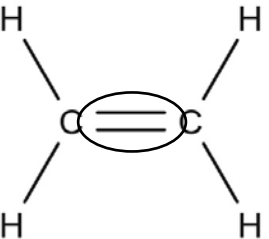
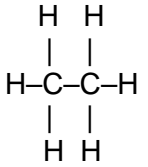
The breakdown of Assessment Objectives for GCSE (9-1) in Chemistry B:

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

| Question |         | Answer  | Marks | AO element                    | Guidance   |
|----------|---------|---|-------|-------------------------------|--|
| 1        | (a)     | An acid is reacting with an alkali (to form a salt plus water) / AW ✓   | 1     | 1.2                           | <b>ALLOW</b> the reaction between acid and a base  |
|          | (b) (i) | an indicator ✓<br><u>changes</u> colour ✓   | 2     | 1.2                           | <b>ALLOW</b> named acid-base indicator<br><b>IGNORE</b> details of any quoted colour change  |
|          | (ii)    | Take readings at eye level / take readings from (bottom of) meniscus / make sure no air in burette / add (the NaOH) drop by drop ✓  | 1     | 3.3b                          | <b>ALLOW</b> AW for any of the points<br><b>ALLOW</b> repeat and look for a similar value ;  |
|          | (c) (i) | $(25.80 - 0.90) = 24.9(0)$ ✓  | 1     | 2.2                           |  |
|          | (ii)    | 24.95 not used/is an outlier ✓<br>Mean = $(24.55 + 24.65 + 24.6) \div 3 = 24.6(0)$ ✓  | 2     | 3.2a<br>1.2                   | <b>ALLOW</b> Mean = $(24.55 + 24.65) / 2 = 24.6(0)$<br><b>ALLOW 1 mark for</b> correct calculation of a mean using all 4 values (= 24.7 / 24.6875)   |
|          | (iii)   | <b>FIRST CHECK THE ANSWER ON ANSWER LINE</b><br><b>If answer = 0.0037 or <math>3.7 \times 10^{-3}</math> (g) award 4 marks</b><br>Rearrange to mass of acid = $0.0908 \div$ volume of acid ✓<br><br>= $0.0908 \div 24.6$ ✓<br>= 0.00369.... (g) ✓<br>= 0.0037 or $3.7 \times 10^{-3}$ (g) (2sf) ✓ | 4     | 1.2<br><br>2 x 2.2<br><br>1.2 | <b>ALLOW</b> rearrangement mark if it is clear that 0.0908 is being divided by a volume, even if volume is incorrect.<br><br><b>ALLOW ECF</b> if incorrect volume is calculated in (ii) and used in (iii)<br><b>ALLOW</b> sf mark on incorrect calculation |

| Question |     |       | Answer   | Marks | AO element | Guidance  |
|----------|-----|-------|--|-------|------------|---|
| 2        | (a) | (i)   | When the fizzing stops ✓   | 1     | 3.3a       |   |
|          |     | (ii)  | (broken-up tablet)<br>greater surface area (of solid) (AW) ✓<br><br>more solid particles can react (in the same time) /<br>more (successful / frequent) collisions ✓ | 2     | 1.1        |   |
|          | (b) |       | Particles gain <u>activation</u> energy (AW) / <u>frequency</u> of collisions is greater / more <u>successful</u> collisions ✓                                       | 1     | 1.1        |   |
|          | (c) | (i)   | (the fizz means) a gas is being given off/made / carbon dioxide is being given off/made ✓  | 1     | 2.2        |   |
|          |     | (ii)  | Gradient/slope decreasing ✓  | 1     | 2.2        | <b>ALLOW</b> idea that the curve is less steep (as time increases)<br><br><b>IGNORE</b> time increases and mass decreases |
|          |     | (iii) | (Rate of reaction decreases as):<br>number of (reactant) particles decreases / particles further apart ✓   | 1     | 2.2        | <b>ALLOW</b> reactants/tablet/water used up<br><b>IGNORE</b> particles have less energy                                   |



| Question |         | Answer   | Marks | AO element | Guidance   |
|----------|---------|--|-------|------------|--|
| 3        | (a)     | Ring around C=C ✓<br> | 1     | 2.1        | <b>ALLOW</b> carbon atoms in the ring<br><b>DO NOT ALLOW</b> hydrogen atoms in the ring. |
|          | (b)     | $2.4 \times 10^{24}$ ✓   | 1     | 2.2        |  |
|          | (c) (i) | bromine ✓  | 1     | 1.2        | <b>IGNORE</b> any state<br><b>DO NOT ALLOW</b> bromide                                   |
|          | (ii)    |                       | 1     | 1.2        |  |

| Question |     |      | Answer  | Marks | AO element | Guidance   |
|----------|-----|------|---|-------|------------|--|
| 4        | (a) | (i)  | Temperature increases (quickly at first and more slowly later) ✓  | 1     | 3.1a       | <b>ALLOW</b> temperature increases                                   |
|          |     | (ii) | 1993 – 2017 / any two consecutive years between 2011 to 2017 ✓  | 1     | 3.2b       | <b>ALLOW</b> +/- 1 year<br><b>ALLOW</b> from 2011 to 2017 +/- 1 year |
|          | (b) | (i)  | (Amaya is incorrect because)<br>Any <b>two</b> from:<br><br>CO <sub>2</sub> is in whole (lower) atmosphere / not a 'layer' (AW) ✓<br>CO <sub>2</sub> /gases in the atmosphere absorb IR ✓<br>CO <sub>2</sub> /gases in the atmosphere re-emits IR ✓ | 2     | 3.1b       | <b>ALLOW</b> CO <sub>2</sub> doesn't reflect IR                      |
|          |     | (ii) | Any <b>one</b> from:<br>Drive fewer cars ✓<br>more efficient cars / plant trees ✓<br>don't cut trees down ✓<br>change from non-renewables to renewables ✓<br>burn less fossil fuels ✓   | 1     | 1.1        | <b>ALLOW</b> use electric cars/hydrogen as a fuel                    |
|          | (c) |      | Any <b>one</b> from:<br>fewer places where crops can be grown ✓<br>extreme weather patterns ✓<br>named change to climate ✓<br>melting of polar ice ✓<br>rising sea levels ✓<br>flooding of low land ✓   | 1     | 1.1        |  |

| Question |     |      | Answer  | Marks | AO element | Guidance  |
|----------|-----|------|---|-------|------------|---|
| 5        | (a) | (i)  | Wire ✓<br><br>(place) sample in (Bunsen) flame ✓<br><br>Blue/colourless flame must be used ✓  | 3     | 1.2        | <b>ALLOW</b> splint   |
|          |     | (ii) | purple/violet/mauve/lilac ✓   | 1     | 1.2        | <b>ALLOW</b> blue-purple etc but not 'blue' alone                           |
|          | (b) |      | $\text{BaCl}_2(\text{aq}) + \text{K}_2\text{SO}_4(\text{aq}) \rightarrow \text{BaSO}_4(\text{s}) + 2\text{KCl}(\text{aq})$<br>Species of products ✓<br>balancing ✓<br>state symbols ✓ | 3     | 2.2        | If no marks <b>ALLOW (1)</b> for 1 correct product or one (s) product shown |
|          | (c) | (i)  | (Fertiliser E) contains potassium / potassium and other metal(s) ✓  | 1     | 3.2b       | <b>ALLOW</b> Fertiliser E contains potassium sulfate                        |
|          |     | (ii) | Sensitivity / accuracy / speed / AW / don't have to judge colours ✓   | 1     | 1.1        | <b>ALLOW</b> can give quantitative information                              |

| Question |     | Answer   | Marks                       | AO element | Guidance   |                               |
|----------|-----|--|-----------------------------|------------|--|-------------------------------|
| 6        | (a) | (Jane wrong) (nail X will rust because) air/oxygen is present (dissolved in the water) ✓<br><br>(Ben correct) (nail Y will not rust because) zinc is more reactive than iron ✓ | 2                           | 3.1b       | <b>ALLOW</b> idea that zinc is a sacrificial metal<br><b>IGNORE</b> idea that zinc stops rusting because it is wrapped around the iron alone |                               |
|          | (b) | (i)  | Fe ✓                        | 1          | 3.2b   |                               |
|          |     | (ii)   | It (iron) loses electrons ✓ | 1          | 1.1  | <b>ALLOW</b> oxygen is gained |
|          | (c) |  | Iron(III) hydroxide ✓       | 1          | 1.1  |                               |

| Question  |      |       | Answer  |   | Marks | AO element | Guidance   |  |   |  |   |   |  |   |  |   |   |                  |  |
|---|------|-------|---|---|-------|------------|--|--|---|--|---|---|--|---|--|---|---|------------------|--|
| 7   | (a)  | (i)   | CH <sub>2</sub> ✓   |   | 1     | 2.2        |  |  |   |  |   |   |  |   |  |   |   |                  |  |
|   |      | (ii)  | <pre> H   H       C — C       H   CH<sub>3</sub> </pre> <p>No double bond seen in structure ✓<br/>(No double bond and) rest of structure correct ✓</p>  |   | 2     | 2.2        | ALLOW CH <sub>3</sub> drawn as a displayed formula<br>ALLOW CH <sub>3</sub> in any position                                      |  |   |  |   |   |  |   |  |   |   |                  |  |
|   | (b)  |       | <p>Any <b>one</b> from:<br/>hot liquids are at a lower temperature than the melting point of poly(propene)/aluminium ✓<br/>idea that the melting point of aluminium/poly(propene) is above the boiling point of water ✓</p> |   | 1     | 3.1b       | IGNORE yes/no<br>ALLOW polymers soften below their melting point<br>IGNORE aluminium has a higher melting point than polypropene |  |   |  |   |   |  |   |  |   |   |                  |  |
|   | (c)  |       |   | <table border="1"> <thead> <tr> <th></th> <th>True</th> <th>False</th> </tr> </thead> <tbody> <tr> <td>When monomers form condensation polymers, a small molecule is also formed.</td> <td>✓</td> <td></td> </tr> <tr> <td>DNA is a polymer formed from nucleotides.</td> <td>✓</td> <td></td> </tr> <tr> <td>To make a condensation polymer, each monomer needs only one functional group.</td> <td></td> <td>✓</td> </tr> </tbody> </table> |       | True       | False  | When monomers form condensation polymers, a small molecule is also formed. | ✓ |  | DNA is a polymer formed from nucleotides. | ✓ |  | To make a condensation polymer, each monomer needs only one functional group. |  | ✓ | 3 | 1.1x2<br><br>2.1 |  |
|   | True | False |   |   |       |            |  |  |   |  |   |   |  |   |  |   |   |                  |  |
| When monomers form condensation polymers, a small molecule is also formed.    | ✓    |       |   |   |       |            |  |  |   |  |   |   |  |   |  |   |   |                  |  |
| DNA is a polymer formed from nucleotides.                                     | ✓    |       |   |   |       |            |  |  |   |  |   |   |  |   |  |   |   |                  |  |
| To make a condensation polymer, each monomer needs only one functional group. |      | ✓     |   |   |       |            |  |  |   |  |   |   |  |   |  |   |   |                  |  |

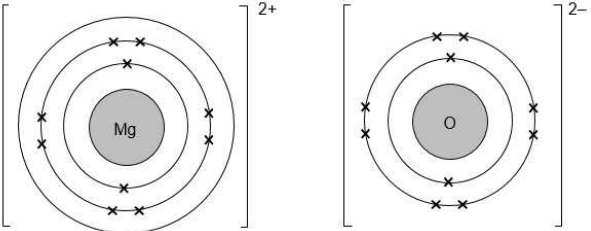
| Question                     |             | Answer   | Marks | AO element | Guidance   |                 |         |  |                              |             |        |   |     |  |
|------------------------------|-------------|--|-------|------------|--|-----------------|---------|--|------------------------------|-------------|--------|---|-----|--|
| 8                            | (a)         | <p>(In graphite) bonds/links/attractions between the layers are weak ✓</p> <p>(In graphite) so layers can separate/slide over each other AW ✓</p> <p>all diamond atoms held by strong bonds ✓</p>  | 3     | 2.1        | <p><b>ALLOW</b> intermolecular forces between layers in graphite</p> <p><b>DO NOT ALLOW</b> intermolecular forces in diamond</p> |                 |         |  |                              |             |        |   |     |  |
|                              | (b)         | (giant) ionic (structure) ✓  | 1     | 1.1        | <p><b>ALLOW</b> 'ionic lattice' or 'ionic' or 'regular ionic'</p> <p><b>IGNORE</b> 'bonding'</p>                                 |                 |         |  |                              |             |        |   |     |  |
|                              | (c)         | <table border="1"> <thead> <tr> <th></th> <th>Graphite</th> <th>Sodium Chloride</th> </tr> </thead> <tbody> <tr> <td>(Conducts when)</td> <td>(Solid)</td> <td>(either molten or) in aqueous/solution ✓</td> </tr> <tr> <td>(Particles that conduct are)</td> <td>electrons ✓</td> <td>ions ✓</td> </tr> </tbody> </table> |       | Graphite   | Sodium Chloride  | (Conducts when) | (Solid) | (either molten or) in aqueous/solution ✓ | (Particles that conduct are) | electrons ✓ | ions ✓ | 3 | 1.1 | <b>IGNORE</b> (Sodium chloride conducts when) liquid |
|                              | Graphite    | Sodium Chloride  |       |            |  |                 |         |  |                              |             |        |   |     |  |
| (Conducts when)              | (Solid)     | (either molten or) in aqueous/solution ✓   |       |            |  |                 |         |  |                              |             |        |   |     |  |
| (Particles that conduct are) | electrons ✓ | ions ✓   |       |            |  |                 |         |  |                              |             |        |   |     |  |

| Question |         | Answer   | Marks | AO element | Guidance                               |
|----------|---------|--|-------|------------|--|
| 9        | (a)     | Rate of forward reaction = rate of back reaction (AW) ✓  | 1     | 1.2        | ALLOW 'they are the same'              |
|          | (b) (i) | Temperature = 350 °C and Pressure = 1.5 (MPa) ✓  | 1     | 2.2        | ALLOW pressure between 1.3 and 1.6MPa  |
|          | (ii)    | Reaction is slow / rate of reaction low ✓  | 1     | 2.2        |  |
|          | (iii)   | <p><b>FIRST CHECK THE ANSWER ON ANSWER LINE</b><br/> <b>If answer = 68 (tonnes) award 3 marks</b></p> <p>RFM of NH<sub>3</sub> = 14 + 3 = 17 ✓<br/> Shows mole ratio is 3:2 OR correctly converts g to tonnes ✓<br/> Mass of NH<sub>3</sub> = 17 x 2/3 x (6x10<sup>6</sup>) = 68x10<sup>6</sup>g = 68 tonnes ✓</p> | 3     | 2.2        | ALLOW ECF from incorrect RFM for max 2 |
|          | (c)     | <p>filter ✓</p> <p>wash (with water) (and dry) ✓</p>   | 2     | 1.2        |  |
|          | (d)     | (Compound fertilisers) contain other elements / K / P (that act as fertilisers) ✓  | 1     | 2.1        |  |

| Question |     | Answer  | Marks   | AO element     | Guidance   |                                      |
|----------|-----|---|---|----------------|--|--------------------------------------|
| 10       | (a) | <p><b>FIRST CHECK THE ANSWER ON ANSWER LINE</b><br/> <b>If answer = 5.1 (g) award 3 marks</b></p> <p>Shows in working (<math>1 \div 6.9</math>) <b>OR</b> 71 and 13.8 <b>OR</b> 35.5 and 6.9 ; ✓<br/> <math>(71/13.8 \text{ OR } 35.5/6.9 =) 5.14492754</math> ✓<br/>           = 5.1 (g) (1dp) ✓</p> | 3   | 2.2 x 2<br>1.2 | <p><b>ALLOW</b> <math>A_r \text{ Li} = 7</math></p> <p><b>ALLOW (2 marks):</b> <math>71/6.9 = 10.3</math><br/> <b>ALLOW (1)</b> for incorrect answer to 1 dp</p> |                                      |
|          | (b) | <p><math>2\text{Li} + 2\text{H}_2\text{O} \rightarrow 2\text{LiOH} + \text{H}_2</math><br/>           correct species ✓</p> <p>1 mark for balanced equation ✓</p>   | 2   | 1.2            |  |                                      |
|          | (c) | <p>cathode: lithium (metal) ✓</p> <p>anode: chlorine (gas) ✓</p>  | 2   | 1.2            | <p><b>ALLOW</b> (1) for correct products in reverse order.<br/> <b>DO NOT ALLOW</b> 'chloride'<br/> <b>IGNORE</b> formulae</p>                                   |                                      |
|          | (d) | (i)   | <p>Add chlorine to a (solution of a metal) bromide / AW ✓</p> <p>Brown colour seen ✓</p>  | 2              | 2.2<br>1.2   | <b>ALLOW</b> any named metal bromide |
|          |     | (ii)  | <p>Avoid inhalation / ventilation / work in fume cupboard ✓</p> <p>Chlorine is toxic / poisonous / harmful / irritant (gas) ✓</p> | 2              | 2.2  |                                      |



| Question |         | Answer  | Marks | AO element         | Guidance   |
|----------|---------|---|-------|--------------------|--|
| 11       | (a)     | (positive/metal) ions and electrons ✓<br><br>have strong electrostatic forces / opposite charges idea / positive and negative attract ✓   | 2     | 1.1                |  |
|          | (b)     | They both conduct electricity ✓<br><br>They both form cations ✓   | 2     | 1.1                |  |
|          | (c) (i) | amount of reactant (atoms) used to make (useful) product / amount of wasted reactant (atoms) (AW) ✓   | 1     | 1.1                | <b>DO NOT ALLOW</b> references to yield  |
|          | (ii)    | <b>FIRST CHECK THE ANSWER ON ANSWER LINE</b><br><b>If answer = 60 (%) award 3 marks</b><br><br>47.9 OR 79.9 ✓<br>(47.9 ÷ 79.9) × 100 = 59.99..... ✓<br>= 60 (%) (2 sf) ✓  | 3     | 2 × 2.2<br><br>1.2 | <b>Allow ECF</b> for incorrect RFMs<br><b>Allow sf</b> mark on incorrect calculation |
|          | (iii)   | Method 2<br><b>AND any one from:</b><br>since method 1 has more reactants / ✓<br>method 1 has Mg on LHS / method 2 has only one reactant / ✓<br>denominator in fraction is bigger for method 1 / ✓<br>larger mass or percentage of waste products / ✓<br>fewer wasted atoms ✓ | 1     | 2.2                | <b>ALLOW</b> atom economy of method 1 is 37%   |

|  |                   |  |                 |                    |   |
|--|-------------------|--|-----------------|--------------------|---|
|  |                   | <p><b>(iv)</b> (Either Jamal or Mia are correct)<br/>                 Any <b>three</b> from:<br/>                 Higher AE wastes fewer atoms / less chemicals / less waste ✓<br/>                 yield may be low / reaction may reach equilibrium ✓<br/>                 rate may be low ✓<br/>                 some by-products may be toxic/harmful / by-products may not harm the environment ✓<br/>                 may requires high energy input / use fossil fuels / produces greenhouse gases / other named pollutant ✓<br/>                 by-products may be useful / oxygen is a useful by product<br/>                 AW ✓</p> | <p><b>3</b></p> | <p><b>3.1b</b></p> | <p><b>IGNORE</b> 'pollution' or 'pollutants' alone</p>  |
|  | <p><b>(d)</b></p> |  <p>✓✓</p>   | <p><b>2</b></p> | <p><b>1.2</b></p>  | <p><b>ALLOW</b> electrons as all dots, all crosses, or a mixture of both which represent electrons moving from Mg to O.</p> |

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