

**GCSE (9–1)**

**Combined Science (Chemistry) A (Gateway Science)**

**J250/03: Paper 3 (Foundation Tier)**

General Certificate of Secondary Education

**Mark Scheme for Autumn 2021**

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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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## 1. 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                                 |

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

| Annotation          | Meaning                                                       |
|---------------------|---------------------------------------------------------------|
| /                   | 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                                           |

### 3. 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.

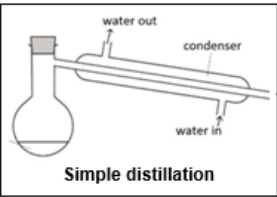
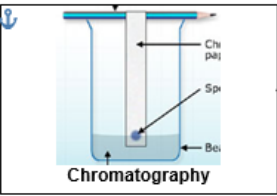
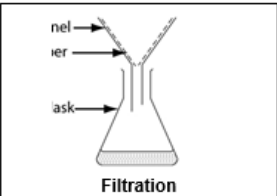
You should ensure also that you are familiar with the administrative procedures related to the marking process. These are set out in the OCR booklet **Instructions for Examiners**. If you are examining for the first time, please read carefully **Appendix 5 Introduction to Script Marking: Notes for New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

|              | <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        |  |  | C ✓    | 1     | 1.1        | ALLOW Ca |
| 2        |  |  | D ✓    | 1     | 2.1        |          |
| 3        |  |  | A ✓    | 1     | 1.1        |          |
| 4        |  |  | B ✓    | 1     | 1.1        |          |
| 5        |  |  | B ✓    | 1     | 2.1        |          |
| 6        |  |  | B ✓    | 1     | 2.1        |          |
| 7        |  |  | C ✓    | 1     | 2.1        |          |
| 8        |  |  | A ✓    | 1     | 2.2        |          |
| 9        |  |  | C ✓    | 1     | 2.1        |          |
| 10       |  |  | B ✓    | 1     | 1.1        |          |

| Question | Answer                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Marks | AO element | Guidance |
|----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|------------|----------|
| 11       | <div data-bbox="383 272 658 469">  </div> <div data-bbox="383 485 658 681">  </div> <div data-bbox="383 697 658 893">  </div> <div data-bbox="383 909 658 1106">  </div> <div data-bbox="775 331 1052 406"> <p>Separates a solvent from a solution. ✓</p> </div> <div data-bbox="775 539 1052 614"> <p>Separates a dissolved solid from a solution. ✓</p> </div> <div data-bbox="775 751 1052 826"> <p>Separates a mixture of dissolved substances from one another. ✓</p> </div> <div data-bbox="775 963 1052 1038"> <p>Separates an insoluble solid from a liquid. ✓</p> </div> | 4     | 1.2        |          |

| Question |     |  | Answer                                                                                                                                  | Marks | AO element | Guidance                                             |
|----------|-----|--|-----------------------------------------------------------------------------------------------------------------------------------------|-------|------------|------------------------------------------------------|
| 12       | (a) |  | C ✓                                                                                                                                     | 1     | 1.1        | <b>ALLOW</b> CuCO <sub>3</sub> (or copper carbonate) |
|          | (b) |  | B ✓                                                                                                                                     | 1     | 1.1        | <b>ALLOW</b> Cu <sub>2</sub> O (or copper oxide)     |
|          | (c) |  | C ✓                                                                                                                                     | 1     | 2.2        | <b>ALLOW</b> CuCO <sub>3</sub> (or copper carbonate) |
|          | (d) |  | <b>FIRST CHECK ANSWER ON ANSWER LINE</b><br><b>If answer = 159.1 award 2 marks</b><br><br>$(63.5 \times 2) + 32.1$ ✓<br><br>$= 159.1$ ✓ | 2     | 2.2        |                                                      |

| Question |     |  | Answer                                                                                                                                                                                                                                 | Marks | AO element         | Guidance                                                                                                                                                                                                             |
|----------|-----|--|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|--------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 13       | (a) |  | Conical flask ✓                                                                                                                                                                                                                        | 1     | 1.2                |                                                                                                                                                                                                                      |
|          | (b) |  | (dropping pipette) is more accurate /<br>measures volume to one decimal place ✓                                                                                                                                                        | 1     | 3.1b               | <b>ALLOW</b> idea that dropping pipette measures to 0.5 cm <sup>3</sup> whereas 0.5 cm <sup>3</sup> is difficult to get exactly with measuring cylinder<br><br>Assume “it” refers to dropping pipette if unqualified |
|          | (c) |  | All points plotted correctly = 2 marks ✓✓<br><b>BUT</b><br>3 or 4 points plotted correctly = 1 mark ✓<br><br>smooth line of best fit through all points ✓                                                                              | 3     | 2 x 2.2<br><br>1.2 | <b>ALLOW</b> ± ½ square                                                                                                                                                                                              |
|          | (d) |  | 6(.0) (cm <sup>3</sup> ) ✓                                                                                                                                                                                                             | 1     | 3.2b               |                                                                                                                                                                                                                      |
|          | (e) |  | 3 correct = 2 marks ✓✓<br>1 or 2 correct = 1 mark ✓<br><br>The <b>hydrogen ions</b> in the dilute hydrochloric acid react with<br><br>the <b>hydroxide ions</b> in the sodium hydroxide solution<br><br>to make <b>water molecules</b> | 2     | 1.2                | <b>ALLOW</b> use of H <sup>+</sup> , OH <sup>-</sup> , H <sub>2</sub> O                                                                                                                                              |

| Question |     |      | Answer                                                                                                                                                                                                               | Marks | AO element | Guidance                                                                      |
|----------|-----|------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|------------|-------------------------------------------------------------------------------|
| 14       | (a) |      | <div>Part of the heating curve</div> <div>1      2      3      4</div> <div>Letter</div> <div>D      B      C      A</div> <p>4 correct = 3 marks ✓✓✓<br/> 2 or 3 correct = 2 marks ✓✓<br/> 1 correct = 1 mark ✓</p> | 3     | 2.1        |                                                                               |
|          | (b) |      | <p>The idea that the water has boiled and is now water vapour / steam / a gas ✓</p> <p><b>OR</b></p> <p>The idea that (the water/ the gas) has escaped from the beaker / is no longer in the beaker ✓</p>            | 1     | 3.1b       |                                                                               |
|          | (c) | (i)  | A or C ✓                                                                                                                                                                                                             | 1     | 3.2b       |                                                                               |
|          |     | (ii) | Idea that a pure substance melts at one temperature ✓                                                                                                                                                                | 1     | 3.2b       | <b>ALLOW</b> idea that an impure substance melts over a range of temperatures |

| Question |     |       | Answer                                                                                                                                                                                       | Marks | AO element     | Guidance                                                                                                    |
|----------|-----|-------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|----------------|-------------------------------------------------------------------------------------------------------------|
| 15       | (a) |       | $2\text{Na(s)} + \text{Cl}_2\text{(g)} \rightarrow 2\text{NaCl(s)}$ ✓                                                                                                                        | 1     | 2.2            | <b>ALLOW</b> correct multiples e.g.<br>$4\text{Na(s)} + 2\text{Cl}_2\text{(g)} \rightarrow 4\text{NaCl(s)}$ |
|          | (b) |       | (Sodium atom) loses one electron ✓<br><br>Idea that it obtains a full outer shell /<br>Idea that it attains a noble gas configuration ✓                                                      | 2     | 2.1<br><br>1.1 | <b>ALLOW</b> idea of losing electrons for 1 mark if no other mark scored                                    |
|          | (c) |       | Idea that (electrostatic) forces between ions are strong ✓<br><br>and require a lot of <u>energy</u> to break ✓                                                                              | 2     | 2.1            | <b>DO NOT ALLOW</b> covalent bonds / intermolecular forces / metallic bonds are strong                      |
|          | (d) | (i)   | $\text{NaCl(aq)}$ ✓                                                                                                                                                                          | 1     | 1.1            |                                                                                                             |
|          |     | (ii)  | No (✓) for solid sodium chloride<br><br>Yes (✓) for solution of sodium chloride ✓                                                                                                            | 1     | 1.2            | <b>Both answers</b> required for the mark                                                                   |
|          |     | (iii) | <b>Solid sodium chloride</b><br><u>ions</u> cannot move / <u>ions</u> fixed in position / <u>ions</u> only vibrate ✓<br><br><b>Solution of sodium chloride</b><br><u>ions</u> free to move ✓ | 2     | 1.2            |                                                                                                             |

| Question | Answer                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Marks | AO element                     | Guidance                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|----------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|--------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 16*      | <p>Please refer to the marking instructions on page 4 of this mark scheme for guidance on how to mark this question.</p> <p><b>Level 3 (5–6 marks)</b><br/>           Uses knowledge and understanding of atomic structure to describe similarities in the atomic structures of helium and neon.<br/> <b>AND</b><br/>           Applies knowledge and understanding of atomic structure to describe differences in the atomic structures of helium and neon.<br/> <b>AND</b><br/>           Analyses and interprets information to quantitatively describe differences in the atomic structures of helium and neon.</p> <p><i>There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.</i></p> <p><b>Level 2 (3–4 marks)</b><br/>           Analyses and interprets information to quantitatively describe differences in the atomic structures of helium and neon.<br/> <b>OR</b><br/>           Uses knowledge and understanding of atomic structure to describe similarities in the atomic structures of helium and neon.<br/> <b>AND</b><br/>           Applies knowledge and understanding of atomic structure to describe differences in the atomic structures of helium and neon.</p> <p><i>There is a line of reasoning presented with some</i></p> | 6     | 2 x 1.1<br>2 x 2.1<br>2 x 3.1a | <p><b>AO1.1 Demonstrate knowledge and understanding</b></p> <ul style="list-style-type: none"> <li>atoms made up of protons, neutrons and electrons</li> <li>contain a central nucleus</li> <li>surrounded by electrons</li> <li>nucleus contains protons and neutrons</li> <li>electrons in energy levels / shells</li> <li>outer energy level / shell full</li> </ul> <p><b>AO2.1 Apply knowledge and understanding of scientific ideas</b><br/>           Helium and neon:</p> <ul style="list-style-type: none"> <li>have different numbers of protons</li> <li>have different numbers of neutrons</li> <li>have different numbers of electrons</li> <li>have different numbers of electron shells</li> <li>have different numbers of electrons in their outer shells</li> </ul> <p><b>AO3.1a Analyse information to interpret data</b></p> <ul style="list-style-type: none"> <li>Helium has               <ul style="list-style-type: none"> <li>2 protons, 2 neutrons, 2 electrons</li> <li>has 2 electrons in its outer energy level / shell</li> <li>has an electron arrangement of 2</li> </ul> </li> <li>Neon has               <ul style="list-style-type: none"> <li>10 protons, 10 neutrons, 10 electrons</li> <li>has 8 electrons in its outer energy level / shell</li> <li>has an electron arrangement of 2, 8</li> </ul> </li> </ul> |

| Question |  |  | Answer                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Marks | AO element | Guidance |
|----------|--|--|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|------------|----------|
|          |  |  | <p><i>structure. The information presented is relevant and supported by some evidence.</i></p> <p><b>Level 1 (1–2 marks)</b><br/>           Uses knowledge and understanding of atomic structure to describe similarities in the atomic structures of helium and neon.</p> <p><b>OR</b><br/>           Applies knowledge and understanding of atomic structure to describe differences in the atomic structures of helium and neon.</p> <p><b>OR</b><br/>           Attempts to analyse and interpret information to quantitatively describe differences in the atomic structures of helium and neon.</p> <p><i>There is an attempt at a logical structure with a line of reasoning. The information is in the most part relevant.</i></p> <p><b>0 marks</b><br/> <i>No response or no response worthy of credit.</i></p> |       |            |          |

| Question |     |      | Answer                                                                                                                                                                                                                                                                              | Marks | AO element                                                | Guidance                                                                                                                                                                                       |
|----------|-----|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|-----------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 17       | (a) | (i)  | Temperature decreases / AW ✓                                                                                                                                                                                                                                                        | 1     | 1.1                                                       | <b>IGNORE</b> answers based on transfer of energy from surroundings                                                                                                                            |
|          |     | (ii) | -3.5 (°C) / as a negative ✓                                                                                                                                                                                                                                                         | 1     | 1.1                                                       |                                                                                                                                                                                                |
|          | (b) |      | Idea of measuring temperature of sodium hydrogen carbonate solution before adding citric acid ✓<br><br>Idea of measuring lowest temperature reached / largest temperature change ✓                                                                                                  | 2     | 3.3a                                                      |                                                                                                                                                                                                |
|          | (c) |      | <b>FIRST CHECK ANSWER ON ANSWER LINE</b><br><b>If answer = 1860 (mg) award 4 marks</b><br><br>(0.65 ÷ 3.5) × 10.0 ✓<br><br>= 1.857 (g) ✓<br><br>= (1.857 × 1000) = 1857 (mg) ✓<br><br>= 1860 (mg) ✓                                                                                 | 4     | 3 x 2.2<br><br><br><br><br><br><br><br><br><br><b>1.2</b> | <b>ALLOW</b> alternative methods for MP1 e.g. 10/3.5 x 0.65 = 1.857g<br><br><b>ECF</b> from incorrect calculation of mass in g<br><br><b>ECF</b> from incorrect calculation for 3 sig fig mark |
|          | (d) |      | Idea that solid left is unreacted (citric acid) / idea that not all the crystals have dissolved ✓<br><br>Idea that temperature change not as large as it should be / calculated mass would be too low ✓<br><br><b>Improvement:</b><br>Stir the solution when citric acid is added ✓ | 3     | 3.3b                                                      | <b>ALLOW</b> use less solid / citric acid <b>OR</b> use more (sodium hydrogen carbonate) solution <b>OR</b> use more concentrated (sodium hydrogen carbonate) solution                         |
|          | (e) |      | Na <sub>3</sub> (C <sub>6</sub> H <sub>5</sub> O <sub>7</sub> ) <b>OR</b> Na <sub>3</sub> C <sub>6</sub> H <sub>5</sub> O <sub>7</sub> ✓                                                                                                                                            | 1     | 2.2                                                       | <b>ALLOW</b> C <sub>6</sub> H <sub>5</sub> O <sub>7</sub> Na <sub>3</sub>                                                                                                                      |

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