



**GCSE (9-1)**

**Chemistry A**

**(Gateway Science)**

**J248/03: Paper 3 (Higher Tier)**

General Certificate of Secondary Education

**Mark Scheme for June 2019**

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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                                 |

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                                      |
| DO NOT ALLOW | Answers which are not worthy of credit                        |
| IGNORE       | Statements which are irrelevant                               |
| ALLOW        | Answers that can be accepted                                  |
| ( )          | Words which are not essential to gain credit                  |
| —            | Underlined words must be present in answer to score a mark    |
| ECF          | Error carried forward                                         |
| AW           | Alternative wording                                           |
| ORA          | 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:

|              | Assessment Objective                                                                                                                                  |
|--------------|-------------------------------------------------------------------------------------------------------------------------------------------------------|
| <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.                                                                                     |

SECTION A

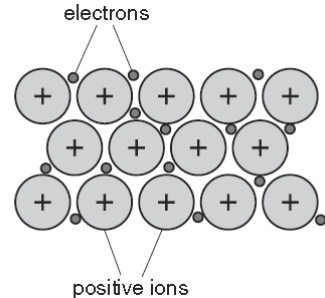
For answers to Section A if an answer box is blank ALLOW correct indication of answer e.g. circled or underlined.

| Question | Answer | Marks | AO element | Guidance |
|----------|--------|-------|------------|----------|
| 1        | C ✓    | 1     | 1.1        |          |
| 2        | D ✓    | 1     | 1.1        |          |
| 3        | D ✓    | 1     | 1.1        |          |
| 4        | B ✓    | 1     | 1.1        |          |
| 5        | A ✓    | 1     | 1.1        |          |
| 6        | C ✓    | 1     | 2.1        |          |
| 7        | B ✓    | 1     | 1.1        |          |
| 8        | C ✓    | 1     | 2.1        |          |
| 9        | C ✓    | 1     | 2.1        |          |
| 10       | C ✓    | 1     | 2.2        |          |
| 11       | D ✓    | 1     | 2.2        |          |
| 12       | C ✓    | 1     | 1.2        |          |
| 13       | B ✓    | 1     | 2.2        |          |
| 14       | A ✓    | 1     | 1.1        |          |
| 15       | D ✓    | 1     | 2.1        |          |
|          | Total  | 15    |            |          |

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| Question |     |       | Answer                                                                                                                              | Marks | AO element | Guidance                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|----------|-----|-------|-------------------------------------------------------------------------------------------------------------------------------------|-------|------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 16       | (a) | (i)   | Positive (metal) <b>ions or cations</b> (in a lattice structure) ✓<br><br>Surrounded by sea of or delocalised electrons ✓           | 2     | 1.1        | <p><b>Any reference to ionic or covalent bonding or IMF scores 0</b></p> <p><b>ALLOW</b> a labelled diagram</p>  <p>If diagram must be at least one electron in the body of the ions<br/>Diagram must show <b>close packed</b> metal ions, in a regular arrangement<br/><b>ALLOW</b> - / e / e<sup>-</sup> / dots for electrons<br/><b>ALLOW</b> Circles with + or circles labelled ions<br/><b>IGNORE</b> free electrons</p> <p>If e or e<sup>-</sup> used don't need labelling</p> |
|          |     | (ii)  | Idea that layers or rows or sheets (of particles) slide over each other ✓                                                           | 1     | 1.1        | <p><b>IGNORE</b> layers can bend<br/><b>IGNORE</b> IMF</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|          |     | (iii) | Has electrons ✓<br><br>(Electrons) can move / that can carry the charge ✓<br><br><b>BUT</b><br>Delocalised electrons scores 2 marks | 2     | 1.1        | <p><b>DO NOT ALLOW</b> free ions – scores 0</p> <p><b>IGNORE</b> free (electrons) for idea of movement</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                              |

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| Question |            |             | Answer                                                                                                                                                                                                                                                                             | Marks    | AO element  | Guidance                                                                                                                                                                                                                                                                                            |
|----------|------------|-------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|-------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|          | <b>(b)</b> |             | <p>Low density<br/><b>and</b> idea that aircraft is lightweight / isn't too heavy to fly / less weight to carry / AW ✓</p> <p>High strength<br/><b>and</b> idea that aircraft is less likely to be damaged ✓</p>                                                                   | <b>2</b> | <b>3.2b</b> | <p><b>DO NOT ALLOW</b> light / lighter for low density but <b>ALLOW</b> so aircraft is light or lighter</p> <p><b>Answers must give property and explanation for marks</b><br/><b>BUT ALLOW</b> 1 mark for low density and high strength / <b>strongest</b> if no or only one explanation given</p> |
|          | <b>(c)</b> | <b>(i)</b>  | (Percentage of lithium =) $(2 \div 10) \times 100 = 20(\%)$ ✓                                                                                                                                                                                                                      | <b>1</b> | <b>3.1a</b> |                                                                                                                                                                                                                                                                                                     |
|          |            | <b>(ii)</b> | <p>Idea that alloy B is only 2.2% lithium /</p> <p>Idea that alloy B is 2.2% lithium but the diagram has 20% lithium /</p> <p>Idea that the % of lithium in the alloy is much smaller than in the diagram /</p> <p>there should be 100 aluminium atoms (and 2 lithium atoms) ✓</p> | <b>1</b> | <b>3.2a</b> | <p><b>ALLOW</b> ECF from incorrect percentage in (c)(i)<br/><b>ALLOW</b> should be more Al atoms / 17.8% too large</p> <p><b>IGNORE</b> references to the relative sizes of the atoms</p>                                                                                                           |

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| Question |     |     | Answer                                                                                                                                                                                                                                                                                                                                   | Marks | AO element                | Guidance                                                                                                                                                                                                                                                                                                                                                                                                                |
|----------|-----|-----|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|---------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 17       | (a) |     | <p>Could be breathed in /</p> <p>Idea of absorbed by skin /</p> <p>Idea of absorbed into bloodstream /</p> <p>Take a long time to break down in the environment ✓</p>                                                                                                                                                                    | 1     | 2.1                       | <p><b>ALLOW</b> cannot see so may leave (areas of) skin unprotected</p> <p><b>ALLOW</b> idea that we don't know the <b>long term</b> risks</p> <p><b>IGNORE</b> idea that they are not fully understood / there could be side effects / idea that they may react with or irritate skin / harmful to humans</p>                                                                                                          |
|          | (b) |     | <p><b>FIRST CHECK THE ANSWER ON ANSWER LINE</b></p> <p><b>If answer = 0.12 OR 0.12:1 OR 1:8.3 award 4 marks</b></p> <p>Surface area = <math>6 \times 50^2 = 15000</math> ✓</p> <p>Volume = <math>50^3 = 125000</math> ✓</p> <p>Surface area / volume ratio<br/>= <math>15000 \div 125000</math> ✓</p> <p>= 0.12 or 0.12:1 or 1:8.3 ✓</p> | 4     | <p>3 x 2.2</p> <p>1.2</p> | <p><b>Units not needed</b></p> <p><b>ALLOW</b> surface area = <math>1.5 \times 10^4 \text{ nm}^2</math></p> <p><b>ALLOW</b> volume = <math>1.25 \times 10^5 \text{ nm}^3</math></p> <p><b>ALLOW</b> ECF from incorrect surface area and/or volume</p> <p><b>ALLOW</b> any <b>simplified</b> ratio consistent with 0.12:1 eg 3:25 or 1.5:12.5 for 4 marks</p> <p><b>DO NOT ALLOW</b> ratio wrong way round eg 1:0.12</p> |
|          | (c) | (i) | <p>Nanoparticles have diameter between 1 - 100 (nm) / idea that (diameter of) DNA is more than 1 (nm) but less than 100 (nm) ✓</p> <p>Water (molecule) is too small / 0.27 (nm) is less than 1 (nm) / idea that 0.27 (nm) is not in range 1 – 100 (nm) ✓</p>                                                                             | 2     | 1.1                       | <p><b>ALLOW</b> has at least one dimension on the nanoscale</p>                                                                                                                                                                                                                                                                                                                                                         |

| Question |  |      | Answer                                                                                                                                             | Marks | AO element | Guidance                                                                                                                          |
|----------|--|------|----------------------------------------------------------------------------------------------------------------------------------------------------|-------|------------|-----------------------------------------------------------------------------------------------------------------------------------|
|          |  | (ii) | <b>FIRST CHECK THE ANSWER ON ANSWER LINE</b><br><b>If answer = 3100 award 2 marks</b><br><br>100000 ÷ 32 ✓<br><br>= 3100 (2 significant figures) ✓ | 2     | 2.2        | <b>ALLOW</b> 3125 for 1 mark<br><br><b>ALLOW</b> 0.00032 for 1 mark (correct sig figs from incorrect working out, ie 32 ÷ 100000) |

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| Question |     |       | Answer                                                                                                                                                                | Marks | AO element  | Guidance                                                                                                                                                                                                                                        |
|----------|-----|-------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|-------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 18       | (a) | (i)   | Methanol ✓<br>(because it has the) lowest boiling point ✓                                                                                                             | 2     | 3.2b        | IGNORE (because it has the) lowest melting point                                                                                                                                                                                                |
|          |     | (ii)  | Particles (are close together in a liquid and) move further apart in a gas ✓                                                                                          | 1     | 1.1         | <b>Answer must be comparative</b><br><b>ALLOW</b> idea that arrangement of particles becomes less regular or more random<br><b>IGNORE</b> the idea that movement increases                                                                      |
|          |     | (iii) | Particles move more quickly (in all directions) in a gas ✓                                                                                                            | 1     | 1.1         | <b>Answer must be comparative</b><br><b>IGNORE</b> particles have more (kinetic) energy<br><b>IGNORE</b> the idea that movement increases                                                                                                       |
|          |     | (iv)  | Fractionating column ✓<br>Large surface area ✓                                                                                                                        | 2     | 3.3b<br>1.2 | <b>ALLOW</b> fractional (distillation) column<br><b>IGNORE</b> distillation / fractional distiller                                                                                                                                              |
|          | (b) |       | More energy is given out during bond making than is taking in during bond breaking / AW ✓                                                                             | 1     | 1.1         | <b>DO NOT ALLOW</b> ideas about more bonds<br><br><b>IGNORE</b> idea that more energy is <b>used</b> during bond making than is taken in during bond breaking<br><b>IGNORE</b> idea that it takes more energy to make bonds than to break bonds |
|          | (c) | (i)   | <b>FIRST CHECK THE ANSWER ON ANSWER LINE</b><br><b>If answer = (+)3057 (kJ/mol) award 2 marks</b><br><br>(413 x 3) + (358) + (464) + (2 x 498) ✓<br>= 3057 (kJ/mol) ✓ | 2     | 2.2         | <b>IGNORE</b> + or - sign                                                                                                                                                                                                                       |
|          |     | (ii)  | <b>FIRST CHECK THE ANSWER ON ANSWER LINE</b><br><b>If answer = (-)3466 (kJ/mol) award 2 marks</b><br><br>(805 x 2) + (464 x 4) ✓<br>= 3466 (kJ/mol) ✓                 | 2     | 2.2         | <b>IGNORE</b> + or - sign                                                                                                                                                                                                                       |
|          |     | (iii) | 3057 – 3466 = -409 (kJ/mol) ✓                                                                                                                                         | 1     | 2.2         | <b>ALLOW</b> ecf from parts (i) and (ii)<br><b>DO NOT ALLOW</b> +409                                                                                                                                                                            |

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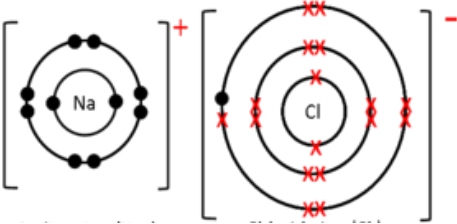
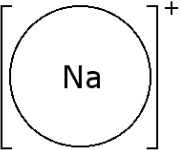
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| Question    |                   |                    | Answer                                                                                                                                                                                                                                                                                                | Marks   | AO element        | Guidance                                                                                                                                                                                            |                     |             |    |    |    |             |    |    |    |   |     |  |
|-------------|-------------------|--------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------|-------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|-------------|----|----|----|-------------|----|----|----|---|-----|--|
| 19          | (a)               | (i)                | C ✓<br><br>Low density <b>and</b> good <b>electrical</b> conductor ✓                                                                                                                                                                                                                                  | 2       | 3.2a<br><br>1.1   | <b>Second mark is dependent on correct choice of C</b><br><b>BOTH</b> properties required for second mark<br><b>IGNORE</b> good conductor<br><b>DO NOT ALLOW</b> light / lighter for low density    |                     |             |    |    |    |             |    |    |    |   |     |  |
|             |                   | (ii)               | Idea of a feature of a substance that can be observed or measured ✓                                                                                                                                                                                                                                   | 1       | 1.1               | <b>ALLOW</b> a specific example<br>eg the appearance of something or the state (of matter) or melting point / boiling point<br><b>IGNORE</b> idea of a property that is reversible                  |                     |             |    |    |    |             |    |    |    |   |     |  |
|             | (b)               |                    | Dissolve gas or oxide in water / make a solution of the oxide ✓<br><br>Test with universal indicator (paper) ✓<br><br>(universal indicator) would turn blue / pH greater than 7 ✓                                                                                                                     | 3       | 3.3a              | <b>ALLOW</b> shake gas or oxide with water<br><br><b>ALLOW</b> use a pH meter / pH probe<br><b>ALLOW</b> test with (damp) red litmus (paper)<br><br><b>ALLOW</b> (damp red litmus paper) turns blue |                     |             |    |    |    |             |    |    |    |   |     |  |
|             | (c)               | (i)                | <table border="1"><thead><tr><th>Isotope</th><th>Number of protons</th><th>Number of neutrons</th><th>Number of electrons</th></tr></thead><tbody><tr><td>Chlorine-35</td><td>17</td><td>18</td><td>17</td></tr><tr><td>Chlorine-37</td><td>17</td><td>20</td><td>17</td></tr></tbody></table> ✓<br>✓ | Isotope | Number of protons | Number of neutrons                                                                                                                                                                                  | Number of electrons | Chlorine-35 | 17 | 18 | 17 | Chlorine-37 | 17 | 20 | 17 | 2 | 1.1 |  |
| Isotope     | Number of protons | Number of neutrons | Number of electrons                                                                                                                                                                                                                                                                                   |         |                   |                                                                                                                                                                                                     |                     |             |    |    |    |             |    |    |    |   |     |  |
| Chlorine-35 | 17                | 18                 | 17                                                                                                                                                                                                                                                                                                    |         |                   |                                                                                                                                                                                                     |                     |             |    |    |    |             |    |    |    |   |     |  |
| Chlorine-37 | 17                | 20                 | 17                                                                                                                                                                                                                                                                                                    |         |                   |                                                                                                                                                                                                     |                     |             |    |    |    |             |    |    |    |   |     |  |

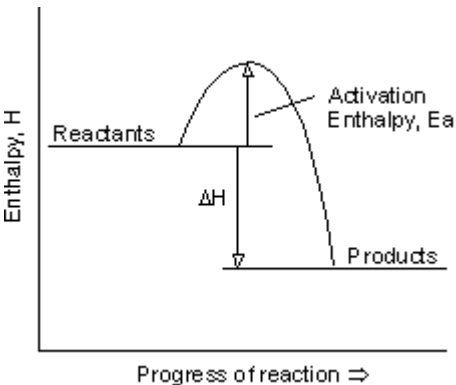
| Question |  |       | Answer                                                                                                                                                   | Marks | AO element | Guidance                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|----------|--|-------|----------------------------------------------------------------------------------------------------------------------------------------------------------|-------|------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|          |  | (ii)  | $\text{Cl}_2 + 2\text{e}^- \rightarrow 2\text{Cl}^-$ ✓                                                                                                   | 1     | 2.1        | <p><b>ALLOW</b> <math>\text{Cl}_2 \rightarrow 2\text{Cl}^- - 2\text{e}^-</math></p> <p><b>ALLOW</b> any correct multiple, including fractions</p> <p><b>ALLOW</b> <math>= / \rightleftharpoons</math> instead of <math>\rightarrow</math></p> <p><b>DO NOT ALLOW</b> and / &amp; instead of '+'</p> <p>balancing mark is dependent on the correct formulae but</p>                                                                                                                                                                                                     |
|          |  | (iii) | <p><math>\text{Ba}^{2+}(\text{aq}) + \text{SO}_4^{2-}(\text{aq}) \rightarrow \text{BaSO}_4(\text{s})</math></p> <p>Equation ✓</p> <p>State symbols ✓</p> | 2     | 2.1        | <p><b>ALLOW</b> any correct multiple, including fractions</p> <p><b>ALLOW</b> <math>= / \rightleftharpoons</math> instead of <math>\rightarrow</math></p> <p><b>DO NOT ALLOW</b> and / &amp; instead of '+'</p> <p><b>Mark for state symbols is dependent on correct species</b></p> <p><b>ALLOW</b> a full <b>balanced</b> ionic equation</p> <p><math>\text{Ba}^{2+}(\text{aq}) + 2\text{Cl}^-(\text{aq}) + 2\text{Na}^+(\text{aq}) + \text{SO}_4^{2-}(\text{aq}) \rightarrow \text{BaSO}_4(\text{s}) + 2\text{Na}^+(\text{aq}) + 2\text{Cl}^-(\text{aq})</math></p> |

| Question |     |       | Answer                                                                                                                                                                                                                                                | Marks | AO element             | Guidance                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|----------|-----|-------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 20       | (a) | (i)   | x-axis labelled volume of hydrochloric acid in cm <sup>3</sup><br>and<br>y-axis labelled pH ✓<br><br>All points plotted correctly ✓<br><br>Line of best fit drawn ✓                                                                                   | 3     | 2.2 x 2<br><br>1.2     | <br><br><b>ALLOW</b> ±½ square<br><br>Must be identifiable as a titration curve                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|          |     | (ii)  | Answer ± 0.1cm <sup>3</sup> of their own graph ✓                                                                                                                                                                                                      | 1     | 2.2                    | <b>Scores 0 if no line of best fit in (a)(i)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|          |     | (iii) | Decreases ✓                                                                                                                                                                                                                                           | 1     | 3.1a                   | <b>ALLOW</b> diluted                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|          |     | (iv)  | H <sup>+</sup> + OH <sup>-</sup> → H <sub>2</sub> O ✓                                                                                                                                                                                                 | 1     | 1.1                    | <b>ALLOW</b> correct multiples<br><b>IGNORE</b> state symbols                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|          | (b) |       | Strong acids are fully ionised or completely dissociated (in aqueous solution) ✓<br><br><br><br><br><br>Weak acids are partially ionised or not completely dissociated (in aqueous solution) ✓                                                        | 2     | 1.1                    | <b>ALLOW</b> all molecules release H <sup>+</sup> ions<br><b>ALLOW</b> HCl → H <sup>+</sup> + Cl <sup>-</sup><br><b>DO NOT ALLOW</b> strong acids have many H <sup>+</sup> ions / strong acids have a high concentration of H <sup>+</sup> ions<br><b>IGNORE</b> strong acids are more ionised / dissociated<br><br><b>ALLOW</b> not all molecules release H <sup>+</sup> ions<br><b>ALLOW</b> CH <sub>3</sub> COOH ⇌ CH <sub>3</sub> COO <sup>-</sup> + H <sup>+</sup><br><b>DO NOT ALLOW</b> weak acids have few H <sup>+</sup> ions / weak acids have a low concentration of H <sup>+</sup> ions |
|          | (c) | (i)   | <b>FIRST CHECK THE ANSWER ON ANSWER LINE</b><br><b>If answer = pH 4 award 2 marks</b><br><br>Concentration of H <sup>+</sup> decreases by factor of 10, the pH increases by 1 ✓<br><br>Factor of 100 = 10 x 10 so pH increases by 2<br>pH value = 4 ✓ | 2     | <br><br>2.1<br><br>2.2 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |

| Question |  |       | Answer                                                                                                                                                                                                                                                   | Marks | AO element | Guidance                                                                                                                                                                                              |
|----------|--|-------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|          |  | (ii)  | $\text{HNO}_3 + \text{NaOH} \rightarrow \text{NaNO}_3 + \text{H}_2\text{O}$ ✓                                                                                                                                                                            | 1     | 1.1        | <b>ALLOW</b> any correct multiple, including fractions<br><b>ALLOW</b> = / $\rightleftharpoons$ instead of $\rightarrow$<br><b>DO NOT ALLOW</b> and / & instead of '+'<br><b>IGNORE</b> state symbols |
|          |  | (iii) | <b>Any two from:</b><br>Evaporate water (slowly) / heat the solution ✓<br>Idea of forming a saturated solution ✓<br>Idea of crystallisation ✓<br>Cool solution (slowly) ✓<br>Idea of drying in a warm oven / air drying / leave on filter paper to dry ✓ | 2     | 3.3a       | <b>DO NOT ALLOW</b> idea of boiling the solution<br><br><b>IGNORE</b> just 'crystals should be dried'                                                                                                 |

| Question   | Answer                                                                                                                                                                                                                                                                                                                                                        | Marks | AO element | Guidance                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 21 (a) (i) | <p><b>Any two from:</b></p> <p>Size of atoms or ions is not accurate ✓</p> <p>Idea that atoms or ions are held together by forces not physical bonds ✓</p> <p>Idea that it show the atoms or ions <b>too far apart</b> ✓</p> <p>There are not really 'sticks' holding the atoms or ions together ✓</p> <p>Charges on <b>ions</b> are not shown ✓</p>          | 2     | 3.1b       | <p><b>ALLOW</b> doesn't show relative size of atoms or ions</p> <p><b>IGNORE</b> idea that you cannot see the forces between the atoms / ions</p> <p><b>DO NOT ALLOW</b> charges on <b>atoms</b> are not shown</p>                                                                                                                                                                                                                                                                                                                                                  |
|            | <p>(ii)</p>  <p>Correct sodium ion / 2.8 <b>OR</b> empty outer shell ✓<br/>ie</p>  <p>Correct chloride ion / 2.8.8<br/><b>OR</b> correct chloride ion showing full outer shell only ✓</p> | 2     | 2.1        | <p>Two correct electronic structures but no charges award one mark</p> <p>Two correct charges with incorrect electronic structure award one mark</p> <p>The ionic charges must <b>not</b> be shown in the nucleus</p> <p>Award 0 marks for structures with shared electrons</p> <p>One electronic structure must be labelled in some way to indicate which ion is which in order to score two marks.</p> <p><b>ALLOW</b> answers showing the transfer of electrons providing the same electrons are not shown twice</p> <p>All electrons can be dots or crosses</p> |

| Question | Answer                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Marks | AO element                     | Guidance                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|----------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|--------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| (b)*     | <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/>Analyses ideas and applies knowledge to explain the formation of the products during the electrolysis of potassium bromide solution, including balanced half equations.<br/><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 ideas and applies knowledge to explain the formation of the products during the electrolysis of potassium bromide solution<br/><b>OR</b><br/>applies knowledge to write balanced half equations.<br/><i>There is a line of reasoning presented with some structure. The information presented is relevant and supported by some evidence.</i></p> <p><b>Level 1 (1–2 marks)</b><br/>Applies knowledge to identify the products formed at the electrodes<br/><b>OR</b><br/>applies knowledge to identify the ions present in the solution<br/><b>OR</b><br/>applies knowledge to identify which ions move to each electrode.<br/><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> | 6     | 2 x 1.1<br>2 x 2.1<br>2 x 3.2b | <p><b>AO1.1 Knowledge of electrolysis</b></p> <ul style="list-style-type: none"> <li>Negative electrode is cathode</li> <li>Positive electrode is anode</li> <li>Ions move to oppositely charged electrodes</li> </ul> <p><b>AO2.1 Apply knowledge and understanding of the electrolysis of salt solutions</b></p> <ul style="list-style-type: none"> <li>Hydrogen ions are discharged more readily than potassium ions, so hydrogen is formed at the cathode</li> <li>Bromide ions are discharged more readily than hydroxide ions, so bromine is formed at the anode</li> <li>Cathode: <math>2\text{H}^+ + 2\text{e}^- \rightarrow \text{H}_2</math> / <math>2\text{H}^+ \rightarrow \text{H}_2 - 2\text{e}^-</math></li> <li>Anode: <math>2\text{Br}^- \rightarrow \text{Br}_2 + 2\text{e}^-</math> / <math>2\text{Br}^- - 2\text{e}^- \rightarrow \text{Br}_2</math></li> </ul> <p><b>AO3.2b Analyse ideas about electrolysis to draw conclusions about the electrolysis of potassium bromide solution</b></p> <ul style="list-style-type: none"> <li>Solution contains <math>\text{K}^+</math> and <math>\text{Br}^-</math> ions from potassium bromide and <math>\text{H}^+</math> and <math>\text{OH}^-</math> ions from water</li> <li>Positive ions / <math>\text{K}^+</math> and <math>\text{H}^+</math> ions move to negative electrode</li> <li>Negative ions / <math>\text{Br}^-</math> and <math>\text{OH}^-</math> ions move to positive electrode</li> </ul> <p><b>DO NOT ALLOW</b> reference to bromine ions</p> |

| Question |     |      | Answer                                                                                                                                                                                                                                                                      | Marks | AO element | Guidance                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|----------|-----|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 22       | (a) | (i)  |  <p>Correctly labelled axes ✓</p> <p>Products shown below reactants ✓</p> <p>Activation energy correctly labelled ✓</p> <p>Energy change or <math>\Delta H</math> correctly labelled ✓</p> | 4     |            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|          |     | (ii) | <p>Carbon donates or gives or loses electrons (to the lead ions) /</p> <p>electrons are transferred from carbon (to lead ions) ✓</p>                                                                                                                                        | 1     | 1.1        | <p><b>IGNORE</b> carbon is oxidised</p> <p><b>IGNORE</b> reference to lead oxide</p> <p><b>DO NOT ALLOW</b> idea of transfer of electrons to oxygen / oxide ion</p>                                                                                                                                                                                                                                                                                                                           |
|          | (b) | (i)  | <p><math>3\text{Pb} + 8\text{HNO}_3 \rightarrow 3\text{Pb}(\text{NO}_3)_2 + 2\text{NO} + 4\text{H}_2\text{O}</math></p> <p>Formulae ✓</p> <p>Balancing ✓</p>                                                                                                                | 2     | 1.1<br>2.2 | <p><b>ALLOW</b> any correct multiple, including fractions</p> <p><b>ALLOW</b> = / <math>\rightleftharpoons</math> instead of <math>\rightarrow</math></p> <p><b>DO NOT ALLOW</b> and / &amp; instead of '+'</p> <p>balancing mark is dependent on the correct formulae but</p> <p><b>ALLOW</b> 1 mark for a balanced equation with a minor error in subscripts / formulae</p> <p>e.g. <math>3\text{PB} + 8\text{HNO}_3 \rightarrow 3\text{Pb}(\text{NO}_3)_2 + 4\text{H}_2\text{O}</math></p> |

J248/03

Mark Scheme

June 2019

| Question |  |      | Answer                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Marks | AO element                | Guidance                                                                                                                                                                                                                                                                                                                                |
|----------|--|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|---------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|          |  | (ii) | <p><b>FIRST CHECK THE ANSWER ON ANSWER LINE</b><br/> <b>If answer = 0.10 award 4 marks</b></p> <p><math>M_r</math> of <math>\text{Pb}(\text{NO}_3)_2 = 331.2</math><br/> <b>or</b><br/> 207g of Pb would produce 331.2g of <math>\text{Pb}(\text{NO}_3)_2</math> /<br/> 20.7g of Pb would produce 33.12g of <math>\text{Pb}(\text{NO}_3)_2</math> ✓</p> <p>Moles = mass <math>\div</math> <math>M_r</math> / <math>33.1 \div 331.2</math> ✓<br/> = 0.09993961 ✓<br/> = 0.10 (2 sig. figs) ✓</p> <p><b>OR</b></p> <p>Ratio of Pb : <math>\text{Pb}(\text{NO}_3)_2</math> is 3:3 / 1:1 ✓</p> <p>RAM of Pb is 207 or 207.2 ✓</p> <p>(so) 20.7g of Pb is 0.10 mol or 0.099903474 ✓<br/> (and so) this will make 0.10 mol of <math>\text{Pb}(\text{NO}_3)_2</math> ✓</p> | 4     | <p>3 x 2.2</p> <p>1.2</p> | <p><b>ALLOW</b> 331</p> <p><b>ALLOW ECF</b> from balanced equation in (i)</p> <p><b>ALLOW</b> 3 marks for 0.1 (ie not 2 sig figs)</p> <p><b>ALLOW ECF</b> from incorrect calculation for sig fig mark</p> <p><b>ALLOW ECF</b> from balanced equation in (i)</p> <p><b>ALLOW ECF</b> for calculation of mol of Pb from incorrect RAM</p> |

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