

# Higher

**GCSE**

**Chemistry A Gateway Science**

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

General Certificate of Secondary Education

**Mark Scheme for June 2022**

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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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**MARKING INSTRUCTIONS****PREPARATION FOR MARKING****RM ASSESSOR**

1. Make sure that you have accessed and completed the relevant training packages for on-screen marking: *RM Assessor Online Training*; *OCR Essential Guide to Marking*.
2. Make sure that you have read and understood the mark scheme and the question paper for this unit. These are available in RM Assessor.
3. Log-in to RM Assessor and mark the **required number** of practice responses (“scripts”) and the **required number** of standardisation responses.

**MARKING**

1. Mark strictly to the mark scheme.
2. Marks awarded must relate directly to the marking criteria.
3. The schedule of dates is very important. It is essential that you meet the RM Assessor 50% and 100% (traditional 50% Batch 1 and 100% Batch 2) deadlines. If you experience problems, you must contact your Team Leader (Supervisor) without delay.
4. If you are in any doubt about applying the mark scheme, consult your Team Leader by telephone, email or via the RM Assessor messaging system.

5. Work crossed out:
- where a candidate crosses out an answer and provides an alternative response, the crossed out response is not marked and gains no marks
  - if a candidate crosses out an answer to a whole question and makes no second attempt, and if the inclusion of the answer does not cause a rubric infringement, the assessor should attempt to mark the crossed out answer and award marks appropriately.
6. Always check the pages (and additional objects if present) at the end of the response in case any answers have been continued there. If the candidate has continued an answer there then add a tick to confirm that the work has been seen.
7. There is a NR (No Response) option. Award NR (No Response)
- if there is nothing written at all in the answer space
  - OR if there is a comment which does not in any way relate to the question (e.g. 'can't do', 'don't know')
  - OR if there is a mark (e.g. a dash, a question mark) which isn't an attempt at the question.

Note: Award 0 marks – for an attempt that earns no credit (including copying out the question).

8. The RM Assessor **comments box** is used by your Team Leader to explain the marking of the practice responses. Please refer to these comments when checking your practice responses. **Do not use the comments box for any other reason.**

If you have any questions or comments for your Team Leader, use the phone, the RM Assessor messaging system, or email.

9. Assistant Examiners will send a brief report on the performance of candidates to their Team Leader (Supervisor) via email by the end of the marking period. The report should contain notes on particular strengths displayed as well as common errors or weaknesses. Constructive criticism of the question paper/mark scheme is also appreciated.

10. For answers marked by levels of response:

Read through the whole answer from start to finish, using the Level descriptors to help you decide whether it is a strong or weak answer. The indicative scientific content in the Guidance column indicates the expected parameters for candidates' answers, but be prepared to recognise and credit unexpected approaches where they show relevance. Using a 'best-fit' approach based on the skills and science content evidenced within the answer, first decide which set of level descriptors, Level 1, Level 2 or Level 3, best describes the overall quality of the answer.

Once the level is located, award the higher or lower mark:

**The higher mark** should be awarded where the level descriptor has been evidenced and all aspects of the communication statement (in italics) have been met.

**The lower mark** should be awarded where the level descriptor has been evidenced but aspects of the communication statement (in italics) are missing.















**In summary:**

**The skills and science content determines the level.**

**The communication statement determines the mark within a level.**

Level of response question on this paper is **18**.

## 11. 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                                 |

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

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

### 13. Subject-specific Marking Instructions

#### INTRODUCTION

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

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

You should ensure that you have copies of these materials.

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

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



The breakdown of Assessment Objectives for GCSE (9-1) in Chemistry 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.   |

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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        | B ✓    | 1     | 1.1        |          |
| 2        | B ✓    | 1     | 1.2        |          |
| 3        | C ✓    | 1     | 1.1        |          |
| 4        | A ✓    | 1     | 1.1        |          |
| 5        | D ✓    | 1     | 1.1        |          |
| 6        | D ✓    | 1     | 1.1        |          |
| 7        | C ✓    | 1     | 1.2        |          |
| 8        | C ✓    | 1     | 1.2        |          |
| 9        | B ✓    | 1     | 2.1        |          |
| 10       | B ✓    | 1     | 1.1        |          |
| 11       | D ✓    | 1     | 1.1        |          |
| 12       | B ✓    | 1     | 2.2        |          |
| 13       | C ✓    | 1     | 2.1        |          |
| 14       | D ✓    | 1     | 2.1        |          |
| 15       | A ✓    | 1     | 2.1        |          |

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| Question |     | Answer  | Marks | AO element | Guidance  |
|----------|-----|---|-------|------------|---|
| 16       | (a) | <p>The model shows how many electrons the carbon atoms have. <input type="checkbox"/></p> <p>The model shows how many electrons the hydrogen atoms have. <input type="checkbox"/></p> <p>The model shows how much space each atom fills. <input type="checkbox"/></p> <p>The model shows that the carbon atoms are bigger than the hydrogen atoms. <input checked="" type="checkbox"/> ✓</p> <p>The model shows the difference between double bonds and single bonds. <input checked="" type="checkbox"/> ✓</p> | 2     | 2 x 2.1    |   |
|          | (b) | <p>Shared pair of electrons ✓</p> <p>Rest of structure correct ✓</p>  | 2     | 2 x 1.2    | <p><b>ALLOW</b> electrons as all dots, all crosses, or a mix of dots and crosses</p> <p><b>ALLOW</b> diagrams with inner electron shells, but inner shells must be correct if shown</p> <p><b>Second marking point is dependent on one shared pair of electrons</b></p> |

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| Question |     | Answer   | Marks | AO element | Guidance  |
|----------|-----|--|-------|------------|---|
| 16       | (c) | <p><b>Any two from:</b></p> <p>Particles are closer together in bromine / further apart in ethene ✓</p> <p>Particles move faster in ethene / move slower in bromine ✓</p> <p>Particles have more energy in ethene / less energy in bromine ✓</p> <p>Particles are arranged more randomly in ethene / less randomly in bromine ✓</p> <p>Forces between particles are stronger in bromine / weaker in ethene ✓</p> | 2     | 2 x 2.1    | <p><b>Answers must be comparative</b></p> <p><b>ALLOW</b> gas for ethene and liquid for bromine</p> <p><b>ALLOW</b> 1 mark for 2 correct ideas without explicit reference to particles</p>                          |
|          | (d) | <p><b>FIRST CHECK THE ANSWER ON ANSWER LINE</b></p> <p><b>If answer = 2 award 3 marks</b></p> <p><math>(2 \times 12.0 = 24.0 \text{ and } 4 \times 1.0 = 4.0)</math> ✓</p> <p><b>OR</b></p> <p><math>24.0 + 4.0 = 28.0</math> ✓</p> <p><math>187.8 - 28.0 = 159.8</math> ✓</p> <p><math>159.8 \div 79.9 = 2</math> ✓</p>   | 3     | 3 x 2.1    | <p><b>ALLOW</b> <math>(2 \times 12 = 24 \text{ and } 4 \times 1 = 4)</math> ✓</p> <p><b>OR</b></p> <p><b>ALLOW</b> <math>24 + 4 = 28</math> ✓</p> <p><b>ALLOW</b> ECF from MP1</p> <p><b>ALLOW</b> ECF from MP2</p> |

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| Question |     |       | Answer   | Marks | AO element | Guidance   |
|----------|-----|-------|--|-------|------------|--|
| 17       | (a) | (i)   | (Paper / gas / thin layer) chromatography  | 1     | 2.2        | <b>ALLOW</b> test or measure melting point / test or measure boiling point   |
|          |     | (ii)  | C <sub>3</sub> H <sub>7</sub>  | 1     | 2.1        | <b>ALLOW</b> H <sub>7</sub> C <sub>3</sub><br><b>DO NOT ALLOW</b> C <sub>3</sub> H <sub>7</sub> or C <sup>3</sup> H <sup>7</sup> or (C <sub>3</sub> H <sub>7</sub> ) <sub>2</sub>  |
|          |     | (iii) | <p><b>Any four from:</b></p> <p>(Simple) distillation ✓<br/><b>BUT</b> fractional distillation ✓✓</p> <p>Use of a condenser ✓</p> <p>Description of liquid (hexane) <u>boiling</u> (to gas) and then condensing (back to liquid) ✓</p> <p>Idea of heating the mixture to or higher than the boiling point of hexane ✓</p> <p>Idea that (hexane will boil at a lower temperature than cyclohexane, so) hexane will be collected first ✓</p> | 4     | 4 x 3.3a   | <p>Marks can be awarded from a labelled diagram</p> <p><b>ALLOW 1 mark</b> for a fractionating column when used with a condenser for idea of fractional distillation</p> <p><b>IGNORE</b> condensing tube</p> <p><b>IGNORE</b> idea of hexane evaporating</p> <p><b>ALLOW</b> hexane will boil first</p> |
|          | (b) | (i)   | <p><b>FIRST CHECK THE ANSWER ON ANSWER LINE</b><br/><b>If answer = 79(%) award 2 marks</b></p> <p><math>\frac{12.0}{15.2} \times 100 = 78.947</math> ✓</p> <p>79 (%) (2 significant figures) ✓</p>   | 2     | 2 x 2.2    | <b>ALLOW</b> ECF for sig fig mark  |
|          |     | (ii)  | 2C <sub>6</sub> H <sub>14</sub> + 19 O <sub>2</sub> → 12 CO <sub>2</sub> + 14 H <sub>2</sub> O ✓   | 1     | 2.1        | <b>ALLOW</b> correct multiples   |

| Question |      | Answer   | Marks | AO element          | Guidance  |
|----------|------|--|-------|---------------------|---|
| 18       | (a)* | <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 the information to correctly identify all 3 solutions as acidic or alkaline<br/><b>AND</b><br/>Uses knowledge and understanding to accurately explain how both tests can determine the acidity/alkalinity of a solution</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 the information to correctly identify all 3 solutions as acidic or alkaline<br/><b>OR</b><br/>Uses knowledge and understanding to attempt to explain how both tests can determine the acidity/alkalinity of a solution<br/><b>OR</b><br/>Analyses the information to correctly identify at least one solution AND discusses how one test can determine the acidity/alkalinity of a solution</p> <p><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/>Analyses the information to correctly identify one solution as acidic or alkaline<br/><b>OR</b></p> | 6     | 3 x 1.1<br>3 x 3.2b | <p><b>AO 1.1 Demonstrates knowledge and understanding of acids and alkalis</b></p> <ul style="list-style-type: none"> <li>• Acids react with carbonates</li> <li>• Alkalis do not react with carbonates</li> <li>• In the reaction between acid and carbonates, carbon dioxide is formed</li> <li>• Carbon dioxide is a gas, so bubbling will be observed</li> <li>• Alkalis are neutralised by the addition of acid</li> <li>• Acids are not neutralised by the addition of acid</li> <li>• Acid + alkali → salt + water</li> </ul> <p><b>AO 3.2b Analyses information and ideas to draw conclusions</b></p> <ul style="list-style-type: none"> <li>• Solution A is neutralised by hydrochloric acid</li> <li>• Solution B and C are not neutralised by hydrochloric acid (therefore must be acidic or neutral)</li> <li>• Solution A does not react with magnesium carbonate (therefore must be alkali or neutral)</li> <li>• Solutions B and C both react with magnesium carbonate</li> <li>• Solution B reacts more vigorously with magnesium carbonate than solution C</li> <li>• Solution A is an alkali</li> <li>• Solution B is an acid</li> <li>• Solution C is an acid</li> <li>• Solution B is a stronger or more concentrated acid than solution C</li> </ul> |

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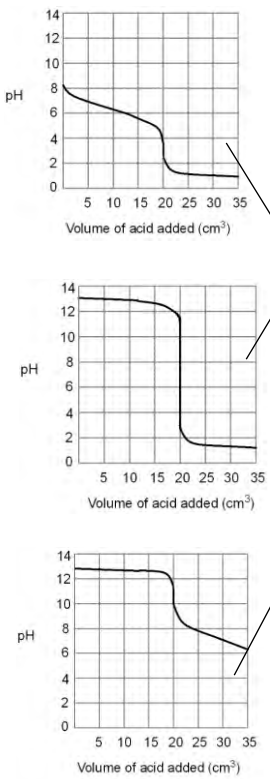
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| Question |  |  | Answer   | Marks | AO element | Guidance |
|----------|--|--|--|-------|------------|----------|
|          |  |  | <p>Uses knowledge and understanding to explain one test and how it can determine the acidity of a solution.</p> <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> |       |            |          |

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| Question | Answer   | Marks | AO element | Guidance  |
|----------|--|-------|------------|---|
| 18 (b)   |  <p>Strong acid added to strong alkali</p> <p>Weak acid added to strong alkali</p> <p>Strong acid added to weak alkali</p> <p>Weak acid added to weak alkali</p> | 3     | 3 x 1.1    |   |
| (c)      | $\text{H}^+(\text{aq}) + \text{OH}^-(\text{aq}) \rightarrow \text{H}_2\text{O}(\text{l})$ <p>Correct formulae ✓<br/>Correct state symbols ✓</p>  | 2     | 2 x 1.1    | <p><b>ALLOW</b> any correct multiple, including fractions<br/><b>ALLOW</b> = instead of →<br/><b>DO NOT ALLOW</b> and / &amp; instead of '+'</p> <p>Second MP is dependent on the first</p> |



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| Question |     |       | Answer   | Marks | AO element | Guidance   |
|----------|-----|-------|--|-------|------------|--|
| 19       | (a) | (i)   |   | 1     | 1.2        | LOBF must go through the origin                            |
|          |     | (ii)  | 10.5 (cm <sup>3</sup> ) ✓  | 1     | 2.2        | ALLOW Answer ± ½ square of their own graph                 |
|          |     | (iii) | Cathode / negative electrode ✓   | 1     | 1.2        |  |
|          |     | (iv)  | Chlorine / Cl <sub>2</sub> ✓   | 1     | 1.2        | DO NOT ALLOW Cl<br>DO NOT ALLOW Chloride / Cl <sup>-</sup> |
|          | (b) |       | <p>Idea that hydrogen is produced (at the cathode) if ions from a more reactive metal (than hydrogen) are present / idea that only 1 ion is discharged at each electrode / discharge is based on the reactivity series / less reactive ions are discharged in preference ✓</p> <p>Hydrogen is less reactive than sodium / ORA ✓</p> <p>Copper is less reactive than hydrogen / ORA ✓</p> | 3     | 3 x 1.2    |  |

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| Question |     | Answer   | Marks | AO element | Guidance   |
|----------|-----|--|-------|------------|--|
|          | (c) | <p>Weigh the <u>negative</u> electrode / <u>cathode</u> before the experiment ✓</p> <p>Weigh the <u>negative</u> electrode / <u>cathode</u> with the copper formed ✓</p> <p>Calculate the change in mass / mass increase ✓</p> | 3     | 3 x 3.3b   | <p><b>ALLOW</b> idea of weighing <u>both</u> electrodes in MP1 and MP2</p> <p>MP3 is independent of MP1 and MP2, i.e. MP3 can still be awarded if anode referred to</p> <p><b>ALLOW</b> for MP3 weigh the mass of copper formed on the cathode / weigh the residue on the cathode</p> <p><b>ALLOW</b> weigh the electrode before the experiment and weigh the electrode after the experiment for 1 mark if no other mark awarded</p> |

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| Question |     |      | Answer  | Marks | AO element                    | Guidance   |
|----------|-----|------|---|-------|-------------------------------|--|
| 20       | (a) | (i)  | <p><b>FIRST CHECK THE ANSWER ON ANSWER LINE</b><br/> <b>If answer = 0.73 / 0.75 / 0.74 award 3 marks</b></p> <p><math>R_f = \frac{\text{distance moved by dye}}{\text{distance moved by solvent}}</math> ✓</p> <p><b>BUT</b><br/> <math>R_f = 4.4 \div 6</math> / <math>R_f = 4.5 \div 6</math> / <math>R_f = 4.45 \div 6</math> ✓✓</p> <p><b>THEN</b><br/> <math>R_f = 0.73</math> / <math>R_f = 0.75</math> / <math>R_f = 0.74</math> (2 significant figures) ✓</p> | 3     | <p>1 x 1.1</p> <p>2 x 2.1</p> | <p><math>R_f</math> calculation scores MP1 and 2</p> <p><b>ALLOW</b> ECF for sig fig mark</p>  |
|          |     | (ii) | <p>(Cake) 1 and (cake) 3 ✓</p> <p>Idea that the spots in the dyes from cakes 1 and 3 match / cakes 1 and 3 both contain blue and yellow colours / idea that blue and yellow spots in cakes 1 and 3 have the same <math>R_f</math> values / idea that the dye in cake 2 contains different substances ✓</p>  | 2     | 2 x 3.2b                      | <p>Second marking point is dependent on choice of cakes 1 and 3</p> <p><b>ALLOW</b> cakes 1 and 3 have the same substances in them</p> |
|          | (b) | (i)  | Formulation ✓   | 1     | 1.1                           |  |
|          |     | (ii) | Alloy ✓   | 1     | 1.1                           |  |
|          | (c) |      | (Use a different) solvent / mobile phase ✓  | 1     | 3.3b                          | <b>ALLOW</b> (use a different) stationary phase  |

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| Question |     |       | Answer   | Marks | AO element                            | Guidance   |
|----------|-----|-------|--|-------|---------------------------------------|--|
| 21       | (a) | (i)   | <p><b>FIRST CHECK THE ANSWER ON ANSWER LINE</b><br/> <b>If answer = 248 (g) award 2 marks</b></p> <p><math>M_r</math> of <math>P_4 = 4 \times 31.0 = 124.0 \checkmark</math></p> <p>Mass of <math>P_4 = 124.0 \times 2 = 248</math> (g) <math>\checkmark</math></p>  | 2     | 2 x 2.2                               | <b>ALLOW</b> ECF from incorrect $M_r$ (but not from $A_r$ of 31.0, i.e. $2 \times 31.0$ )  |
|          |     | (ii)  | <p><b>FIRST CHECK THE ANSWER ON ANSWER LINE</b><br/> <b>If answer = 1100 (g) award 3 marks</b></p> <p>Mole ratio <math>P_4 : PCl_3</math> is 1 : 4<br/> OR 2 moles of <math>P_4</math> makes 8 moles of <math>PCl_3 \checkmark</math></p> <p><math>M_r PCl_3 = 31 + (35.5 \times 3) = 137.5 \checkmark</math></p> <p>Mass of <math>PCl_3 = 137.5 \times 8 = 1100</math> (g) <math>\checkmark</math></p>  | 3     | 3 x 2.2                               | <b>ALLOW</b> ECF from incorrect mole ratio and/or $M_r$  |
|          |     | (iii) | <p>Limiting reagent – phosphorus / <math>P_4 \checkmark</math></p> <p>Moles of <math>Cl_2 = (866.2 \div 71.0 =) 12.2 \checkmark</math></p> <p>Mole ratio of <math>P_4 : Cl_2</math> is 1 : 6 or 2 : 12 <math>\checkmark</math></p> <p>There are 2 mol of <math>P_4</math> to 12.2 mol of <math>Cl_2</math> /<br/> stoichiometry of 1:6.1 /<br/> Idea that the ratio is higher than the stoichiometry of the equation / higher than 1:6 or 2:12 <math>\checkmark</math></p> | 4     | 1 x 2.2<br><br>1 x 1.2<br><br>2 x 2.2 | <p><b>ALLOW</b> idea that the mass of chlorine needed is 852g and there is 866.2g<br/> <b>ALLOW</b> 12.2 moles of <math>Cl_2</math> means that <math>Cl_2</math> is in excess</p> <p><b>IGNORE</b> simply there is less phosphorus than chlorine</p> |

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| Question |     |      | Answer  |                    |                    |                           | Marks | AO element             | Guidance  |
|----------|-----|------|---|--------------------|--------------------|---------------------------|-------|------------------------|---|
| 21       | (b) | (i)  | Name  | Melting point (°C) | Boiling point (°C) | State at room temperature | 2     | 2 x 2.1                | All 3 correct = 2 marks<br>1 or 2 correct = 1 mark  |
|          |     |      | Phosphorus trichloride  | - 94               | 76                 | <b>Liquid</b>             |       |                        |   |
|          |     |      | Phosphorus pentachloride  | 161                | 167                | <b>Solid</b>              |       |                        |   |
|          |     |      | Phosphorus trifluoride  | - 152              | -102               | <b>Gas</b>                |       |                        |   |
|          |     |      | ✓✓  |                    |                    |                           |       |                        |   |
|          |     | (ii) | Phosphorus trifluoride ✓<br><br><b>Any two from:</b><br>Idea that the weakest intermolecular forces require the least energy to break / the least energy to separate the molecules ✓<br><br>Idea that less energy to break the forces means a lower melting point and/or boiling point ✓<br><br>Idea that the weakest intermolecular forces mean a lower melting and/or boiling point ✓ |                    |                    |                           | 3     | 1 x 2.1<br><br>2 x 1.1 | <b>ALLOW</b> phosphorus trifluoride circled in the table<br><br><b>DO NOT ALLOW</b> references to covalent bonds or intermolecular forces between atoms<br><br><b>ALLOW</b> idea that phosphorus trifluoride is a gas (at room temperature) |

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| Question |       | Answer   | Marks | AO element | Guidance  |
|----------|-------|--|-------|------------|---|
|          | (iii) | <p>Idea that giant covalent compounds have high melting points / high boiling points ✓</p> <p>Phosphorus trichloride does not have a high melting point / boiling point<br/> <b>or</b><br/>           Phosphorus trichloride has a low melting point / boiling point ✓</p> | 2     | 2 x 3.1b   | <p><b>ALLOW</b> idea that giant covalent compounds have <u>many</u> strong covalent bonds (which need to be broken)<br/> <b>DO NOT ALLOW</b> references to breaking intermolecular forces in giant covalent compounds</p> <p><b>ALLOW</b> phosphorus trichloride is a liquid (at room temperature)</p> <p><b>DO NOT ALLOW</b> references to strong intermolecular forces OR strong covalent bonds between molecules</p> |

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Mark Scheme

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| Question |     | Answer  | Marks | AO element | Guidance   |   |         |   |
|----------|-----|---|-------|------------|--|---|---------|---|
| 22       | (a) | <p><b>FIRST CHECK THE ANSWER ON ANSWER LINE</b><br/> <b>If answer = <math>1.09 \times 10^{-22}</math> (g) award 3 marks</b></p> <p>Moles of zinc = <math>1 \div 6.02 \times 10^{23} = 1.66113 \times 10^{-24}</math> ✓</p> <p>Mass of one atom = <math>65.4 \times (1.66113 \times 10^{-24})</math><br/> <math>= 1.086379 \times 10^{-22}</math> ✓</p> <p><math>= 1.09 \times 10^{-22}</math> (g) (3 sig figures) ✓</p>   | 3     | 3 x 2.1    | <p><b>ALLOW</b> ECF from incorrect moles of zinc</p> <p><b>ALLOW</b> ECF if significant figures correct from incorrect calculation of mass of one atom</p> |   |         |   |
|          | (a) | <p><b>IF CANDIDATE USES AVOGADRO CONSTANT AS <math>6.02 \times 10^{-23}</math></b></p> <p><b>FIRST CHECK THE ANSWER ON ANSWER LINE</b><br/> <b>If answer = <math>1.09 \times 10^{24}</math> (g) award 3 marks</b></p> <p>Moles of zinc = <math>1 \div 6.02 \times 10^{-23} = 1.6611296 \times 10^{22}</math> ✓</p> <p>Mass of one atom = <math>65.4 \times (1.66113 \times 10^{22})</math><br/> <math>= 1.0863787 \times 10^{24}</math> ✓</p> <p><math>= 1.09 \times 10^{24}</math> (g) (3 sig figures) ✓</p> |       |            | <p><b>ALLOW</b> ECF from incorrect moles of zinc</p> <p><b>ALLOW</b> ECF if significant figures correct from incorrect calculation of mass of one atom</p> |   |         |   |
|          | (b) | (i)   |       |            | <p><math>\text{Zn}^{2+} + 2\text{Br}^- \rightarrow \text{ZnBr}_2</math></p> <p>Formulae ✓<br/> Balancing ✓</p>   | 2 | 2 x 2.1 | <p><b>ALLOW</b> any correct multiple, including fractions<br/> <b>ALLOW</b> = instead of <math>\rightarrow</math><br/> <b>DO NOT ALLOW</b> and / &amp; instead of '+'<br/> <b>IGNORE</b> state symbols</p> <p>balancing mark is dependent on the correct formulae but<br/> <b>ALLOW</b> 1 mark for a balanced equation with a minor error in subscripts / formulae<br/> e.g. <math>\text{Zn}^{2+} + 2\text{BR}^- \rightarrow \text{ZnBr}_2</math></p> |

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| Question |      | Answer   | Marks | AO element | Guidance   |
|----------|------|--|-------|------------|--|
|          | (ii) | <p><b>Zinc bromide</b><br/>Idea that zinc bromide has ions that are free to move when zinc bromide is aqueous or molten /<br/>Idea that zinc bromide has ions that cannot move when zinc bromide is solid ✓</p> <p><b>Zinc metal</b><br/>Has electrons ✓</p> <p>(Electrons) can move / electrons can carry the charge ✓</p> <p><b>BUT</b><br/>Delocalised electrons scores 2 marks</p> | 3     | 3 x 1.1    | <p><b>IGNORE</b> just charged particles throughout the question</p> <p><b>DO NOT ALLOW</b> electrons can move<br/><b>IGNORE</b> bromine ions</p> <p><b>DO NOT ALLOW</b> free ions</p> <p><b>IGNORE</b> free (electrons) for idea of movement<br/><b>IGNORE</b> electrons can carry the electricity</p> |
| (c)      | (i)  | B and D ✓  | 1     | 2.1        | BOTH required for the mark   |
|          | (ii) | <p>B ✓</p> <p>(B is) a nanoparticle so it has a large surface area to volume ratio ✓</p> <p>Idea that (B is) cheap and has a high purity ✓</p>   | 3     | 3 x 3.2a   | <p><b>No marks awarded if B not given</b></p> <p><b>ALLOW</b> B (is the smallest particle so) has the <u>largest</u> surface area to volume ratio</p>  |



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