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# **Mark Scheme (Results)**

Summer 2018

Pearson Edexcel GCSE  
Chemistry (1CH0) Paper 1F

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## General Marking Guidance

- All candidates must receive the same treatment. Examiners must mark the first candidate in exactly the same way as they mark the last.
- Mark schemes should be applied positively. Candidates must be rewarded for what they have shown they can do rather than penalised for omissions.
- Examiners should mark according to the mark scheme not according to their perception of where the grade boundaries may lie.
- There is no ceiling on achievement. All marks on the mark scheme should be used appropriately.
- All the marks on the mark scheme are designed to be awarded. Examiners should always award full marks if deserved, i.e. if the answer matches the mark scheme. Examiners should also be prepared to award zero marks if the candidate's response is not worthy of credit according to the mark scheme.
- Where some judgement is required, mark schemes will provide the principles by which marks will be awarded and exemplification may be limited.
- When examiners are in doubt regarding the application of the mark scheme to a candidate's response, the team leader must be consulted.
- Crossed out work should be marked UNLESS the candidate has replaced it with an alternative response.

Mark schemes have been developed so that the rubrics of each mark scheme reflects the characteristics of the skills within the AO being targeted and the requirements of the command word. So for example the command word 'Explain' requires an identification of a point and then reasoning/justification of the point.

Explain questions can be asked across all AOs. The distinction comes whether the identification is via a judgment made to reach a conclusion, or, making a point through application of knowledge to reason/justify the point made through application of understanding. It is the combination and linkage of the marking points that is needed to gain full marks.

When marking questions with a 'describe' or 'explain' command word, the detailed marking guidance below should be consulted to ensure consistency of marking.

| Assessment Objective |           | Command Word                                                                                                                    |                                                                                                                                         |
|----------------------|-----------|---------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------|
| Strand               | Element   | Describe                                                                                                                        | Explain                                                                                                                                 |
| AO1*                 |           | An answer that combines the marking points to provide a logical description                                                     | An explanation that links identification of a point with reasoning/justification(s) as required                                         |
| AO2                  |           | An answer that combines the marking points to provide a logical description, showing application of knowledge and understanding | An explanation that links identification of a point (by applying knowledge) with reasoning/justification (application of understanding) |
| AO3                  | 1a and 1b | An answer that combines points of interpretation/evaluation to provide a logical description                                    |                                                                                                                                         |
| AO3                  | 2a and 2b |                                                                                                                                 | An explanation that combines identification via a judgment to reach a conclusion via justification/reasoning                            |
| AO3                  | 3a        | An answer that combines the marking points to provide a logical description of the plan/method/experiment                       |                                                                                                                                         |
| AO3                  | 3b        |                                                                                                                                 | An explanation that combines identifying an improvement of the experimental procedure with a linked justification/reasoning             |

\*there will be situations where an AO1 question will include elements of recall of knowledge directly from the specification (up to a maximum of 15%). These will be identified by an asterisk in the mark scheme.

| Question Number | Answer                                                                                                                                                                                | Mark                            |
|-----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------|
| 1(a)(i)         | <p>A electrons</p> <p><b>1. The only correct answer is A</b></p> <p><i>B is factually incorrect</i></p> <p><i>C is factually incorrect</i></p> <p><i>D is factually incorrect</i></p> | <p><b>(1)</b></p> <p>AO 1 1</p> |

| Question Number | Answer          | Additional guidance                                                                       | Mark                             |
|-----------------|-----------------|-------------------------------------------------------------------------------------------|----------------------------------|
| 1(a)(ii)        | NH <sub>3</sub> | <p>do not allow NH<sup>3</sup> / nh<sub>3</sub> / NH3 etc</p> <p>allow H<sub>3</sub>N</p> | <p><b>(1)</b></p> <p>AO 3 2b</p> |

| Question Number | Answer                                            | Additional guidance                                                                             | Mark                            |
|-----------------|---------------------------------------------------|-------------------------------------------------------------------------------------------------|---------------------------------|
| 1(b)(i)         | reversible (reaction) / reaction can go both ways | <p>OWTTE</p> <p>allow reaction is happening forwards and backwards</p> <p>allow equilibrium</p> | <p><b>(1)</b></p> <p>AO 1 1</p> |

| Question Number | Answer                                                     |                  | Mark                             |
|-----------------|------------------------------------------------------------|------------------|----------------------------------|
| 1(b)(ii)        | (the percentage of ammonia produced) decreases / goes down | allow goes lower | <p><b>(1)</b></p> <p>AO 3 1a</p> |

| Question Number | Answer                                 |  | Mark                             |
|-----------------|----------------------------------------|--|----------------------------------|
| 1(b)(iii)       | any number between 15 and 16 inclusive |  | <p><b>(1)</b></p> <p>AO 3 2b</p> |

| Question Number | Answer                                   | Additional guidance                                           | Mark                            |
|-----------------|------------------------------------------|---------------------------------------------------------------|---------------------------------|
| 1(c)(i)         | ammonia + nitric acid → ammonium nitrate | <p>accept reactants in either order</p> <p>ignore formula</p> | <p><b>(1)</b></p> <p>AO 2 1</p> |

| Question Number | Answer                                                                                                                                                                                                                    | Mark                            |
|-----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------|
| 1(c)(ii)        | <p><b>C</b>    <math>\text{NH}_4\text{NO}_3</math></p> <p><b>1. The only correct answer is C</b></p> <p><i>A is factually incorrect</i></p> <p><i>B is factually incorrect</i></p> <p><i>D is factually incorrect</i></p> | <p><b>(1)</b></p> <p>AO 2 1</p> |

| Question Number | Answer                                                                                                                                                                                                                                  | Additional guidance                                                  | Mark                            |
|-----------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------|---------------------------------|
| 1(c)(iii)       | <p>An explanation linking two from:</p> <ul style="list-style-type: none"> <li>• as a fertiliser (1)</li> <li>• contains (a high percentage of) nitrogen (1)</li> <li>• help promote plant growth / increases crop yield (1)</li> </ul> | <p>allow make crops grow faster</p> <p>ignore use as a pesticide</p> | <p><b>(2)</b></p> <p>AO 1 1</p> |

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**(Total for Question 1 = 9 marks)**

| Question Number | Answer                                                                                                                                                                                                                                                            | Additional guidance | Mark                     |
|-----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|--------------------------|
| 2(a)(i)         | A description including any two from : <ul style="list-style-type: none"> <li>• use a pipette filler (1)</li> <li>• wash pipette with sodium hydroxide solution (1)</li> <li>• draw the liquid up so (the bottom of the meniscus) touches the line (1)</li> </ul> |                     | <b>(2)</b><br><br>AO 1 2 |

| Question Number | Answer                                                                                                                                                                                                                                             | Additional guidance                                          | Mark                     |
|-----------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------|--------------------------|
| 2(a)(ii)        | An explanation linking any two from : <ul style="list-style-type: none"> <li>• to remove water from the burette (1)</li> <li>• because this would dilute the original acid (1)</li> <li>• this will give an inaccurate result / ORA (1)</li> </ul> | ignore to avoid contamination<br><br>ignore to kill bacteria | <b>(2)</b><br><br>AO 1 2 |

| Question Number | Answer                          | Additional guidance                                                                                        | Mark                     |
|-----------------|---------------------------------|------------------------------------------------------------------------------------------------------------|--------------------------|
| 2(b)(i)         | phenolphthalein / methyl orange | allow litmus / screened methyl orange / methyl red<br><br>ignore litmus paper<br><br>ignore pH meter/probe | <b>(1)</b><br><br>AO 2 2 |

| Question Number | Answer                                                                                                    | Additional guidance                                                                                    | Mark                      |
|-----------------|-----------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------|---------------------------|
| 2(b)(ii)        | it does not show sharp colour change at end point / not known which colour change gives correct end point | ignore goes through a series of gradual colour changes<br><br>allow does not have a definite end point | <b>(1)</b><br><br>AO 3 1b |

| Question Number | Answer                                                                                                     | Additional guidance                     | Mark                          |
|-----------------|------------------------------------------------------------------------------------------------------------|-----------------------------------------|-------------------------------|
| 2(c)            | 23.65 with or without working scores 2<br><br>OR<br><br>$\frac{23.60 + 23.70}{2} (1)$<br><br>$= 23.65 (1)$ | allow 1 mark for all 3 averaged (24.35) | (2)<br><br>AO 3 2a<br>AO 3 2b |

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(Total for Question 2 = 8 marks)

| Question Number | Answer                                                                                                                                                                 | Additional guidance                             | Mark                 |
|-----------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------|----------------------|
| 3(a)(i)         | <p style="text-align: center;"> <span style="margin-right: 100px;">particle</span> <span>relative charge</span> </p> <p>3 correct = 2 marks<br/>1 correct = 1 mark</p> | do not allow more than 1 line from any particle | <b>(2)</b><br>AO 1 1 |

| Question Number | Answer                                                                                                                                                                                                                                                       | Mark                 |
|-----------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|
| 3(a)(ii)        | <p><b>C     1</b></p> <p><b>1. The only correct answer is C</b></p> <p><i>A is not correct because mass is 1</i></p> <p><i>B is not correct because this is relative mass of electron</i></p> <p><i>D is not correct because mass cannot be negative</i></p> | <b>(1)</b><br>AO 1 1 |

| Question Number | Answer                                                                                                                                                                                                                                                                               | Mark                  |
|-----------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|
| 3(b)            | <p><b>C     magnesium</b></p> <p><b>1. The only correct answer is C</b></p> <p><i>A is not correct because this element is in period 4</i></p> <p><i>B is not correct because this element is in period 4</i></p> <p><i>D is not correct because this element is in period 5</i></p> | <b>(1)</b><br>AO 3 2b |

| Question Number | Answer                                                                                                                                                                                                                                                                          | Additional guidance                                                                                                   | Mark                                         |
|-----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------|----------------------------------------------|
| 3(c)            | <p>A description to include</p> <ul style="list-style-type: none"><li>• both have 18 electrons/2.8.8 (in shells /orbits) (1)</li><li>• both have 18 protons (in the nucleus) (1)</li><li>• argon-38 has 20 neutrons AND argon-40 has 22 neutrons (in the nucleus) (1)</li></ul> | <p>allow argon 40 has <b>two</b> more neutrons than argon 38 / ORA</p> <p>ignore generic definition of an isotope</p> | <p><b>(3)</b></p> <p>AO 3 1a<br/>AO 3 1b</p> |

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**(Total for Question 3 = 7 marks)**

| Question Number | Answer                                                                                                                                                                                                                                                                          | Mark                            |
|-----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------|
| 4(a)            | <p><b>B</b> CH<sub>2</sub></p> <p><b>1. The only correct answer is B</b></p> <p><i>A is not correct because there are not equal C and H</i></p> <p><i>C is not correct because it is not simplest ratio</i></p> <p><i>D is not correct because it is not simplest ratio</i></p> | <p><b>(1)</b></p> <p>AO 2 1</p> |

| Question Number | Answer                                                                                                                              | Additional guidance                                                                                                                                                                                                                                                                                              | Mark                            |
|-----------------|-------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------|
| 4(b)            | <p>56 with or without working (2)</p> <p>OR</p> <p><math>(4 \times 12) + (8 \times 1) = (1)</math></p> <p><math>= 56 (1)</math></p> | <p>allow for ONE mark correctly evaluated expression of form:<br/> <math>(4 \times 12) + (Y \times 1) = \dots</math><br/> <math>(X \times 12) + (8 \times 1) = \dots</math><br/> OR<br/> <math>(8 \times 12) + (4 \times 1) = 100</math><br/> [In each case working and correctly evaluated answer required]</p> | <p><b>(2)</b></p> <p>AO 2 1</p> |

| Question Number | Answer                                                                                                                               | Additional guidance | Mark                     |
|-----------------|--------------------------------------------------------------------------------------------------------------------------------------|---------------------|--------------------------|
| 4(c)(i)         | $\text{C}_4\text{H}_8 + 6\text{O}_2 \rightarrow 4\text{CO}_2 + 4\text{H}_2\text{O}$<br>4CO <sub>2</sub> (1)<br>4H <sub>2</sub> O (1) |                     | <b>(2)</b><br><br>AO 2 1 |

| Question Number | Answer                                                                                                                                                                             | Additional guidance                                                          | Mark                     |
|-----------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------|--------------------------|
| 4(c)(ii)        | A description linking <ul style="list-style-type: none"> <li>• (bubble gas through) limewater (1)</li> <li>• (limewater) turns {milky / cloudy / white precipitate} (1)</li> </ul> | second mark dependent on first<br><br><br><br><br>ignore lit splint goes out | <b>(2)</b><br><br>AO 1 1 |

| Question Number | Answer                                                                                                                                                                                                                                                            | Mark                      |
|-----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------|
| 4(d)            | A      -6      low<br><br><b>1. The only correct answer is A</b><br><br><i>B is not correct because bpt is too high and solubility not high</i><br><br><i>C is not correct because solubility not high</i><br><br><i>D is not correct because bot is too high</i> | <b>(1)</b><br><br>AO 3 2b |

| Question Number | Answer                                                                                                 | Additional guidance                                                                                                                             | Mark                     |
|-----------------|--------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------|
| 4(e)            | high melting point / high boiling point / hard / insoluble (in water) / does not conduct (electricity) | ignore strong bonds<br>ignore strong<br><br>ignore values given<br><br>ignore any other properties but reject contradictions to allowed answers | <b>(1)</b><br><br>AO 1 1 |

**(Total for Question 4 = 9 marks)**

| Question Number | Answer    | Additional guidance | Mark                  |
|-----------------|-----------|---------------------|-----------------------|
| 5(a)            | flammable | allow inflammable   | <b>(1)</b><br>AO 3 2b |

| Question Number | Answer            | Additional guidance                                                                                                                     | Mark                 |
|-----------------|-------------------|-----------------------------------------------------------------------------------------------------------------------------------------|----------------------|
| 5(b)            | barium and sulfur | both elements must be present for the mark<br><br>allow Ba and S<br><br>reject sulfide/sulfate<br>reject if any other elements included | <b>(1)</b><br>AO 2 1 |

| Question Number | Answer                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Additional guidance                                                     | Mark                             |
|-----------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------|----------------------------------|
| 5(c)            | An explanation linking one of the following pairs of points<br><br><ul style="list-style-type: none"> <li>wear gloves (1)</li> <li>{so does not contact/to protect your} skin (1)</li> </ul> OR<br><ul style="list-style-type: none"> <li>wear goggles (1)</li> <li>{so does not contact/to protect} the eyes (1)</li> </ul> OR<br><ul style="list-style-type: none"> <li>use in fume cupboard / mask (1)</li> <li>so you do not inhale it (1)</li> </ul> | second mark dependent on first<br><br>ignore protective/safety clothing | <b>(2)</b><br>AO 3 2a<br>AO 3 2b |

| Question Number | Answer   | Additional guidance                                               | Mark                 |
|-----------------|----------|-------------------------------------------------------------------|----------------------|
| 5(d)(i)         | 25.7 (g) | do not allow 25<br><br>answer may be written on the lower diagram | <b>(1)</b><br>AO 2 1 |

| Question Number | Answer         | Additional guidance         | Mark                 |
|-----------------|----------------|-----------------------------|----------------------|
| 5(d)(ii)        | barium sulfate | do not allow barium sulfide | <b>(1)</b><br>AO 1 2 |

| Question Number | Answer                    | Additional guidance                                                                                                                                                                                                                   | Mark                            |
|-----------------|---------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------|
| 5(e)(i)         | so that the ions can move | <p>allow the solid does not conduct</p> <p>allow conducts when {in solution/liquid}</p> <p>ignore conducts when molten</p> <p>allow so cations / anions can move</p> <p>ignore so particles can move</p> <p>reject electrons move</p> | <p><b>(1)</b></p> <p>AO 2 2</p> |

| Question Number | Answer                                                         | Mark          |
|-----------------|----------------------------------------------------------------|---------------|
| 5(e)(ii)        | OH <sup>-</sup> <u>and</u> Cl <sup>-</sup> <u>only</u> circled | (1)<br>AO 1 1 |

| Question Number | Answer                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Additional guidance                                  | Mark                             |
|-----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------|----------------------------------|
| 5(e)(iii)       | <p>An explanation linking one of the following pairs of points</p> <ul style="list-style-type: none"> <li>• use a crucible/metal container (instead of a beaker) (1)</li> <li>• which will not break/melt (when heated strongly) (1)</li> </ul> <p>OR</p> <ul style="list-style-type: none"> <li>• add a Bunsen burner (under the container) (1)</li> <li>• because heat needed to melt the lead bromide / to make the lead bromide a liquid (1)</li> </ul> | <p>allow blow torch</p> <p>ignore hot water bath</p> | <p>(2)</p> <p>AO 3</p> <p>3b</p> |

**(Total for Question 5 = 10 marks)**

| Question Number | Answer                                                                                                                                                                                                                                                                                      | Mark                            |
|-----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------|
| 6 (a)           | <p>A chromatography</p> <p><b>The only correct answer is A</b></p> <p><i>B is not correct this would not separate colours</i></p> <p><i>C is not correct because this would not separate colours</i></p> <p><i>D is not correct because this would not separate colours in best way</i></p> | <p><b>(1)</b></p> <p>AO 1 1</p> |

| Question Number | Answer                                                                                           | Additional guidance                                           | Mark                            |
|-----------------|--------------------------------------------------------------------------------------------------|---------------------------------------------------------------|---------------------------------|
| 6(b)(i)         | arrows drawn to show water going in the condenser in the bottom and out the condenser at the top | reject arrows drawn coming out of the middle of the condenser | <p><b>(1)</b></p> <p>AO 1 2</p> |

| Question Number | Answer                                                                                                                                           | Additional guidance                                                                                                      | Mark                            |
|-----------------|--------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------|---------------------------------|
| 6(b)(ii)        | <p>An explanation linking</p> <ul style="list-style-type: none"> <li>to cool (1)</li> <li>so (water) {vapour/gas} turns to liquid (1)</li> </ul> | <p>allow water for liquid</p> <p>allow steam for vapour</p> <p>if cooling the ink max 1 for first marking point only</p> | <p><b>(2)</b></p> <p>AO 1 2</p> |

| Question Number | Answer                           | Additional guidance                                                                                                                                                        | Mark                            |
|-----------------|----------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------|
| 6(b)(iii)       | electric heater / heating mantle | <p>allow spirit burner</p> <p>allow hot plate/heated plate</p> <p>allow blow torch</p> <p>ignore heater alone</p> <p>ignore Bunsen burner</p> <p>ignore hot water bath</p> | <p><b>(1)</b></p> <p>AO 2 2</p> |

| Question Number | Answer                                                                                                                                               | Additional guidance                                                                                                                                          | Mark              |
|-----------------|------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|
| 6(c)            | particles at A:<br>white circles only, none touching (1)<br><br>particles at B:<br>white circles only, randomly arranged, more circles than in A (1) | reject 'strings' of particles<br><br>if black circles are present in both boxes allow 1 mark if arrangement of particles in both boxes is otherwise correct. | (2)<br><br>AO 2 1 |

| Question Number | Answer                                                                                                                                                                                                                                                                                      | Additional guidance                                                                    | Mark              |
|-----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------|-------------------|
| 6(d)            | An explanation linking <ul style="list-style-type: none"><li>physical changes do not result in formation of a new substance / chemical change results in formation of a new substance (1)</li><li>physical change is easily reversed / chemical change is not easily reversed (1)</li></ul> | allow no chemical <b>reaction</b> has taken place<br><br>ignore you can see the change | (2)<br><br>AO 1 1 |

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(Total for question 6 = 9 marks)

| Question Number | Indicative content                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Mark                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|-----------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 7(a)            | <p>Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlines in the generic mark scheme.</p> <p>The indicative content below is not prescriptive and candidates are not required to include all the material which is indicated as relevant. Additional content included in the response must be scientific and relevant.</p> <ul style="list-style-type: none"> <li>• an alloy is a mixture of metals</li> <li>• because larger/different sized atoms introduced in alloying,</li> <li>• stop layers moving easily over one another</li> <li>• therefore individual alloy is stronger/harder</li> <li>• an aluminium alloy is magnalium</li> <li>• pure aluminium is not suitable for making aircraft as it bends too easily / too weak</li> <li>• aluminium alloy stronger</li> <li>• magnesium atoms lighter than aluminium atoms,</li> <li>• therefore alloy still low density / lower density than aluminum alone</li> <li>• an iron alloy is stainless steel</li> <li>• pure iron is not suitable for cutlery as it bends too easily / too weak</li> <li>• iron corrodes,</li> <li>• corrosion would contaminate food</li> <li>• stainless steel does not corrode</li> <li>• gold alloy harder</li> <li>• therefore more hard wearing</li> <li>• gold alloys less likely to change shape when worn</li> <li>• alloying can change the colour of the gold</li> </ul> | <p><b>(6)</b></p> <p>AO 2 1<br/>AO 3 1a<br/>AO 3 1b</p>                                                                                                                                                                                                                                                                                                                                                                                    |
| Level           | Mark                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Descriptor                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|                 | 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | <ul style="list-style-type: none"> <li>• No awardable content</li> </ul>                                                                                                                                                                                                                                                                                                                                                                   |
| Level 1         | 1-2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | <ul style="list-style-type: none"> <li>• The plan attempts to link and apply knowledge and understanding of scientific enquiry, techniques and procedures, flawed or simplistic connections made between elements in the context of the question. (AO2)</li> <li>• Analyses the scientific information but understanding and connections are flawed. An incomplete plan that provides limited synthesis of understanding. (AO3)</li> </ul> |

|         |     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|---------|-----|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Level 2 | 3-4 | <ul style="list-style-type: none"> <li>The plan is mostly supported through linkage and application of knowledge and understanding of scientific enquiry, techniques and procedures, some logical connections made between elements in the context of the question. (AO2)</li> <li>Analyses the scientific information and provides some logical connections between scientific enquiry, techniques and procedures. A partially completed plan that synthesises mostly relevant understanding, but not entirely coherently. (AO3)</li> </ul> |
| Level 3 | 5-6 | <ul style="list-style-type: none"> <li>The plan is supported throughout by linkage and application of knowledge and understanding of scientific enquiry, techniques and procedures, logical connections made between elements in the context of the question. (AO2)</li> <li>Analyses the scientific information and provide logical connections between scientific concepts throughout. A well-developed plan that synthesises relevant understanding coherently. (AO3)</li> </ul>                                                          |

| Question Number | Answer         | Additional guidance                                                                                      | Mark                     |
|-----------------|----------------|----------------------------------------------------------------------------------------------------------|--------------------------|
| 7(b)(i)         | gain of oxygen | allow loss of electrons<br><br>allow addition of oxygen<br><br>ignore oxygen reacts with metal/substance | <b>(1)</b><br><br>AO 1 1 |

| Question Number | Answer                                                                                                                                                                                   | Additional guidance              | Mark                     |
|-----------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------|--------------------------|
| 7(b)(ii)        | An explanation linking <ul style="list-style-type: none"> <li>the paint {excludes/acts as a barrier/protective layer/shield} (1)</li> <li>(excludes) air / oxygen / water (1)</li> </ul> | allow rain or moisture for water | <b>(2)</b><br><br>AO 2 2 |

| Question Number | Answer                 | Additional guidance                                                                                                                                                                                                                                           | Mark                     |
|-----------------|------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------|
| 7(b)(iii)       | sacrificial protection | allow coat with plastic / oil / grease<br>allow galvanising<br>allow add a more reactive metal<br><br>ignore to make an alloy<br>ignore painting<br>ignore electroplating<br><br>ignore add another metal alone<br><br>ignore keep away from water/air/oxygen | <b>(1)</b><br><br>AO 1 2 |

| Question Number | Answer                                 | Additional guidance                                                                                               | Mark                     |
|-----------------|----------------------------------------|-------------------------------------------------------------------------------------------------------------------|--------------------------|
| 7(c)(i)         | dc (supply) / direct current / battery | allow power pack<br>allow electrical supply<br>allow power supply<br>allow power source<br><br>ignore electricity | <b>(1)</b><br><br>AO 2 1 |

| Question Number | Answer                                                            | Additional guidance | Mark                     |
|-----------------|-------------------------------------------------------------------|---------------------|--------------------------|
| 7(c)(ii)        | nickel sulfate/nickel chloride/nickel nitrate/soluble nickel salt |                     | <b>(1)</b><br>AO 3<br>3a |

**(Total for question 7 = 12 marks)**

| Question Number | Answer                                                                                                                                                                                                                                                                                                                                                | Additional guidance                                                                                               | Mark              |
|-----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------|-------------------|
| 8(a)            | any two of the following <ul style="list-style-type: none"> <li>• high melting points (1)</li> <li>• high boiling points (1)</li> <li>• malleable (1)</li> <li>• conduct electricity (1)</li> <li>• conduct heat (1)</li> <li>• high density (1)</li> <li>• shiny (1)</li> <li>• ductile (1)</li> <li>• strong (1)</li> <li>• sonorous (1)</li> </ul> | allow bendy as alternative to malleable<br><br>ignore solid<br>ignore hard<br><br>allow good conductor for 1 mark | (2)<br><br>AO 1 2 |

| Question Number | Answer              | Additional guidance                                | Mark          |
|-----------------|---------------------|----------------------------------------------------|---------------|
| 8(b)            | hydrochloric (acid) | allow HCl<br>ignore HCL, hCl, HCL <sub>2</sub> etc | (1)<br>AO 2 1 |

| Question Number | Answer                                                                                                                            | Additional guidance                                                                                                        | Mark              |
|-----------------|-----------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------|-------------------|
| 8(c)(i)         | A description including <ul style="list-style-type: none"> <li>• apply lighted splint (1)</li> <li>• (squeaky) pop (1)</li> </ul> | allow flame / ignite gas / fire<br><br>ignore 'squeaky pop test' / glowing splint<br><br>second mark is dependent on first | (2)<br><br>AO 1 1 |

| Question Number | Answer                                                                                                                             | Additional guidance                                                                                                                                                                                                 | Mark                            |
|-----------------|------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------|
| 8(c)(ii)        | <p>An explanation linking</p> <ul style="list-style-type: none"> <li>loss of electron(s) (1)</li> <li>two electrons (1)</li> </ul> | <p>allow gains two electrons for 1 mark</p> <p>zero marks overall if sharing of electrons / gain or loss of protons / positive electrons</p> <p>marks can be awarded for suitably drawn diagram / half equation</p> | <p><b>(2)</b></p> <p>AO 1 1</p> |

| Question Number | Answer                                                                                                                                                                                                                                                                                                                                                | Additional guidance                                                                                                                                                                                                                              | Mark                            |
|-----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------|
| 8(d)            | <p>final answer of 94 (g dm<sup>-3</sup>) with or without working (2)</p> <p>OR</p> <p><u>23.5</u> (1) (= 0.094)</p> <p>250</p> <p>0.094 x 1000 (1)</p> <p>OR</p> <p><u>250</u> (dm<sup>3</sup>) (1) (= 0.25 (dm<sup>3</sup>))</p> <p>1000</p> <p><u>23.5</u> (1)</p> <p>0.25</p> <p>OR</p> <p><u>1000</u> (1) = 4</p> <p>250</p> <p>4 x 23.5 (1)</p> | <p>allow ECF (error carried forward) throughout</p> <p>other final answers:</p> <p>0.094 / 9.4 (1)</p> <p>0.000094 or 9.4 x 10<sup>-5</sup> (1)</p> <p>0.25 (dm<sup>3</sup>) (1)</p> <p>allow <u>250</u> x 1000 or 10638(.3) (1)</p> <p>23.5</p> | <p><b>(2)</b></p> <p>AO 2 1</p> |

| Question Number | Answer                                                                                                                                                                                                                                                                                                                                            | Additional guidance                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Mark                            |
|-----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------|
| 8(e)            | <p>A description to include</p> <ul style="list-style-type: none"> <li>• filter (1)</li> </ul> <p>and two in a logical order from</p> <ul style="list-style-type: none"> <li>• <b>crystallisation</b> (1)</li> <li>• heat solution (to concentrate) (1)</li> <li>• allow to cool (1)</li> <li>• dry crystals between filter papers (1)</li> </ul> | <p>if filtration not first stage, ignore it and give maximum 2 marks</p> <p>allow description of filtration<br/>ignore filtration to obtain nickel sulfate (crystals)</p> <p>allow 'leave until water evaporates' / use of water bath / evaporate {water/the solution}</p> <p>allow leave {until crystals form / for a few hours / in a warm place / on a window sill}</p> <p>allow 'dry crystals in (warm) oven'</p> <p>if alternative methods of making nickel sulfate solution described, max 1 mark from last four marking points</p> | <p><b>(3)</b></p> <p>AO 2 2</p> |

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**(Total for question 8 = 12 marks)**

| Question Number | Answer                                                                                                                                                                                                                                                                               | Mark                            |
|-----------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------|
| 9(a)(i)         | <p><b>C</b> iron oxide is reduced</p> <p><b>1. The only correct answer is C</b></p> <p><i>A is not correct because carbon gains oxygen</i></p> <p><i>B is not correct because it is not an acid-base reaction</i></p> <p><i>D is not correct because iron oxide loses oxygen</i></p> | <p><b>(1)</b></p> <p>AO 1 1</p> |

| Question Number | Answer                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                                                                                                                                                 | Mark                            |
|-----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------|
| 9(a)(ii)        | <p>final answer of 168 (tonnes) with or without working (3)</p> <p>OR</p> <p>relative formula mass <math>\text{Fe}_2\text{O}_3 = 2 \times 56 + 3 \times 16 (= 160)</math> (1)</p> <p>160 tonnes <math>\text{Fe}_2\text{O}_3</math> produces <math>\{2 \times 56 / 112\}</math> tonnes Fe (1)</p> <p>240 tonnes <math>\text{Fe}_2\text{O}_3</math> produces <math>\frac{2 \times 56}{160} \times 240</math> (1) = 168 (tonnes)</p> <p>OR</p> <p>relative formula mass <math>\text{Fe}_2\text{O}_3 = 2 \times 56 + 3 \times 16 (= 160)</math> (1)</p> <p><math>\frac{240}{160}</math> (1) = 1.5</p> <p><math>1.5 \times 112</math> (1) = 168 (tonnes)</p> <p>OR</p> <p>relative formula mass <math>\text{Fe}_2\text{O}_3 = 2 \times 56 + 3 \times 16 (= 160)</math> (1)</p> <p><math>\frac{112}{160}</math> (1) = 0.7</p> <p><math>0.7 \times 240</math> (1) = 168 (tonnes)</p> | <p>allow ECF throughout</p> <p><math>M_r [\text{Fe}_2\text{O}_3] = 160</math> seen without working (1)</p> <p>allow 320 tonnes : 224 tonnes (1)</p> <p>final answer 84 (tonnes) with or without working (2)</p> <p>Note : final answer 1.5 scores 2 overall</p> | <p><b>(3)</b></p> <p>AO 2 1</p> |

| Question Number | Answer                                                                                                                                                                                                                                 | Additional guidance                                                                                                                                                                                                                                                                                                    | Mark                     |
|-----------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------|
| 9(b)            | <p>An explanation linking the following points</p> <ul style="list-style-type: none"> <li>aluminium is high in reactivity / aluminium oxide is (very) stable (1)</li> <li>aluminium (oxide) cannot be reduced by carbon (1)</li> </ul> | <p>allow<br/>carbon is less reactive than aluminium /<br/>ORA /<br/>aluminium is very reactive<br/>ignore<br/>'aluminium is more reactive' (alone)</p> <p>allow carbon cannot displace aluminium /<br/>aluminium<br/><b>oxide</b> does not react with carbon</p> <p>ignore<br/>aluminium extracted by electrolysis</p> | <p>(2)</p> <p>AO 1 1</p> |

| Question Number | Answer       | Mark                      |
|-----------------|--------------|---------------------------|
| 9(c)            | electrolysis | <p>(1)</p> <p>AO 3 2a</p> |

| Question Number | Indicative content                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                                                                                                                                                                                                                                                                             | Mark                                       |
|-----------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------|
| 9(d)            | <p>Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlines in the generic mark scheme.</p> <p>The indicative content below is not prescriptive and candidates are not required to include all the material which is indicated as relevant. Additional content included in the response must be scientific and relevant.</p> <ul style="list-style-type: none"> <li>• recycling conserves raw materials/natural resources</li> <li>• less power/energy used</li> <li>• therefore conserves fossil fuels</li> <li>• reduces waste in landfill sites</li> <li>• mining for ores avoided</li> <li>• less damage to habitats/landscape</li> <li>• less energy required to melt and reform metals than to extract them</li> <li>• produces less carbon dioxide than extracting/ reduces carbon footprint</li> <li>• carbon dioxide is a greenhouse gas</li> <li>• greenhouse gases cause global warming</li> <li>• avoids use of large amounts of electricity to extract aluminium from its ore</li> <li>• electricity is expensive</li> <li>• avoids release of carbon dioxide when carbon burns</li> <li>• avoids use of large amounts of heat energy needed to extract iron from its ore</li> </ul> <p>IGNORE:</p> <ul style="list-style-type: none"> <li>• environmentally friendly</li> <li>• cheaper</li> <li>• faster</li> <li>• employment</li> </ul> |                                                                                                                                                                                                                                                                                                                                                                                             | <p><b>(6)</b></p> <p>AO 1 1<br/>AO 2 1</p> |
| Level           | Mark                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Descriptor                                                                                                                                                                                                                                                                                                                                                                                  |                                            |
|                 | 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | <ul style="list-style-type: none"> <li>• No awardable content</li> </ul>                                                                                                                                                                                                                                                                                                                    |                                            |
| Level 1         | 1-2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | <ul style="list-style-type: none"> <li>• Demonstrates elements of chemical understanding, some of which is inaccurate. Understanding of scientific ideas lacks detail. (AO1)</li> <li>• The explanation attempts to link and apply knowledge and understanding of scientific ideas, flawed or simplistic connections made between elements in the context of the question. (AO2)</li> </ul> |                                            |

|         |     |                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|---------|-----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Level 2 | 3-4 | <ul style="list-style-type: none"><li>• Demonstrates chemical understanding, which is mostly relevant but may include some inaccuracies. Understanding of scientific ideas is not fully detailed and/or developed. (AO1)</li><li>• The explanation is mostly supported through linkage and application of knowledge and understanding of scientific ideas, some logical connections made between elements in the context of the question. (AO2)</li></ul> |
| Level 3 | 5-6 | <ul style="list-style-type: none"><li>• Demonstrates accurate and relevant chemical understanding throughout. Understanding of the scientific ideas is detailed and fully developed. (AO1)</li><li>• The explanation is supported throughout by linkage and application of knowledge and understanding of scientific ideas, logical connections made between elements in the context of the question. (AO2)</li></ul>                                     |

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**(Total for question 9 = 13 marks)**

| Question Number | Answer                                                                                      | Mark                             |
|-----------------|---------------------------------------------------------------------------------------------|----------------------------------|
| 10(a)(i)        | $2\text{H}_2 (\text{g}) + \text{O}_2 (\text{g}) \rightarrow 2\text{H}_2\text{O} (\text{g})$ | <b>(2)</b><br>AO 3 1a<br>AO 3 1b |

| Question Number | Answer                                                                                    | Additional guidance                                                                                                                                                                                                                                                                            | Mark                     |
|-----------------|-------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------|
| 10(a)(ii)       | all <u>atoms</u> in the reactants are present in the product / only one product is formed | allow no atoms are wasted (in the reaction) / no waste products / nothing is wasted<br><br>allow total mass of reactants = mass of useful products<br><br>allow complete calculation to show that atom economy is 100%<br><br>ignore equation is balanced / same number of atoms on both sides | <b>(1)</b><br><br>AO 1 1 |

| Question Number | Answer                                                                                                                                                                                                                                                            | Additional guidance                                                                                                                                                            | Mark                     |
|-----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------|
| 10(b)           | final answer of 90 with or without working (4)<br><br>OR<br>total mass : $2 \times 223 + 12 / (2 \times 207) + 44 (= 458) (1)$<br><br>mass of useful products : $2 \times 207 = 414$<br><br>$\frac{414}{458} (1) \times 100 (1) (= 90.39)$<br>458<br><br>= 90 (1) | allow ECF throughout<br><br>458 seen (1)<br><br>90.39 / 90.4 for 3 marks<br>110.628... / 111 (2)<br>110 (3)<br><br>correct rounding of an answer with working to 2 sig fig (1) | <b>(4)</b><br><br>AO 2 1 |

| Question Number | Answer                                                                                                                                           | Additional guidance                                     | Mark                     |
|-----------------|--------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------|--------------------------|
| 10(c)(i)        | final answer of 65(%) with or without working (2)<br><br>OR<br>$\frac{7.67}{11.80}$ (= 0.65) (1)<br>$\frac{7.67}{11.80} \times 100$ (=65(%)) (1) | allow any fraction x 100 (1)<br><br>153.84.... scores 1 | <b>(2)</b><br><br>AO 2 1 |

| Question Number | Answer                                                                                                                                                                                                                                                | Additional guidance                                                                             | Mark                     |
|-----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------|--------------------------|
| 10(c)(ii)       | any two from <ul style="list-style-type: none"> <li>incomplete / reversible reactions</li> <li>competing/unwanted/side reactions</li> <li>practical losses during the experiment / loss on transfer from one piece of equipment to another</li> </ul> | ignore<br>gases formed / impure substances / losses through incompetence / products not used up | <b>(2)</b><br><br>AO 1 1 |

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**(Total for Question 10 = 11 marks)**

