



# Mark Scheme (Results)

Summer 2021

Pearson Edexcel International GCSE

In Chemistry (4CH1) Paper 1C and Science  
(Double Award) (4SD0) Paper 1C

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Summer 2021

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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.

| Question number                                            | Answer                                                                                                                                                                                                                                                                                                                                                                                                                     | Notes                                                                                                                     | Marks     |                                 |        |                                   |        |                            |         |                            |                |                                                            |        |                        |   |
|------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------|-----------|---------------------------------|--------|-----------------------------------|--------|----------------------------|---------|----------------------------|----------------|------------------------------------------------------------|--------|------------------------|---|
| 1 (a)                                                      | <table><tr><th>Information</th><th>Substance</th></tr><tr><td>a good conductor of electricity</td><td>copper</td></tr><tr><td>an element that has a basic oxide</td><td>copper</td></tr><tr><td>a substance used as a fuel</td><td>methane</td></tr><tr><td>a major cause of acid rain</td><td>sulfur dioxide</td></tr><tr><td>a non-metallic element that is a solid at room temperature</td><td>iodine</td></tr></table> | Information                                                                                                               | Substance | a good conductor of electricity | copper | an element that has a basic oxide | copper | a substance used as a fuel | methane | a major cause of acid rain | sulfur dioxide | a non-metallic element that is a solid at room temperature | iodine | ALLOW correct formulae | 5 |
| Information                                                | Substance                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                           |           |                                 |        |                                   |        |                            |         |                            |                |                                                            |        |                        |   |
| a good conductor of electricity                            | copper                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                           |           |                                 |        |                                   |        |                            |         |                            |                |                                                            |        |                        |   |
| an element that has a basic oxide                          | copper                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                           |           |                                 |        |                                   |        |                            |         |                            |                |                                                            |        |                        |   |
| a substance used as a fuel                                 | methane                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                           |           |                                 |        |                                   |        |                            |         |                            |                |                                                            |        |                        |   |
| a major cause of acid rain                                 | sulfur dioxide                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                           |           |                                 |        |                                   |        |                            |         |                            |                |                                                            |        |                        |   |
| a non-metallic element that is a solid at room temperature | iodine                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                           |           |                                 |        |                                   |        |                            |         |                            |                |                                                            |        |                        |   |
| (b)                                                        | <p>A description which refers to the following points</p> <p>M1 bubble/add (the gas/carbon dioxide) into limewater</p> <p>M2 (limewater) turns cloudy/milky</p>                                                                                                                                                                                                                                                            | <p>ACCEPT calcium hydroxide</p> <p>ACCEPT white precipitate</p> <p>M2 dep on use of limewater/calcium hydroxide in M1</p> | 2         |                                 |        |                                   |        |                            |         |                            |                |                                                            |        |                        |   |
|                                                            |                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                           | Total 7   |                                 |        |                                   |        |                            |         |                            |                |                                                            |        |                        |   |

| Question number     | Answer                                                                                                                                                                                                                                           | Notes               | Marks         |                 |          |        |    |        |   |    |         |   |   |                                                                                                                                                 |   |
|---------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|---------------|-----------------|----------|--------|----|--------|---|----|---------|---|---|-------------------------------------------------------------------------------------------------------------------------------------------------|---|
| 2 (a) (i)           | <table><tr><th>Sub-atomic particle</th><th>Relative mass</th><th>Relative charge</th></tr><tr><td>electron</td><td>0.0005</td><td>-1</td></tr><tr><td>proton</td><td>1</td><td>+1</td></tr><tr><td>neutron</td><td>1</td><td>0</td></tr></table> | Sub-atomic particle | Relative mass | Relative charge | electron | 0.0005 | -1 | proton | 1 | +1 | neutron | 1 | 0 | 1 mark for each correct answer<br><br>ACCEPT minus one<br>REJECT - unqualified<br><br>ACCEPT one<br>ALLOW +1<br><br>ACCEPT zero/none/ no charge | 3 |
| Sub-atomic particle | Relative mass                                                                                                                                                                                                                                    | Relative charge     |               |                 |          |        |    |        |   |    |         |   |   |                                                                                                                                                 |   |
| electron            | 0.0005                                                                                                                                                                                                                                           | -1                  |               |                 |          |        |    |        |   |    |         |   |   |                                                                                                                                                 |   |
| proton              | 1                                                                                                                                                                                                                                                | +1                  |               |                 |          |        |    |        |   |    |         |   |   |                                                                                                                                                 |   |
| neutron             | 1                                                                                                                                                                                                                                                | 0                   |               |                 |          |        |    |        |   |    |         |   |   |                                                                                                                                                 |   |
| (ii)                | nucleus                                                                                                                                                                                                                                          |                     | 1             |                 |          |        |    |        |   |    |         |   |   |                                                                                                                                                 |   |
| (b) (i)             | U                                                                                                                                                                                                                                                |                     | 1             |                 |          |        |    |        |   |    |         |   |   |                                                                                                                                                 |   |
| (ii)                | 25                                                                                                                                                                                                                                               |                     | 1             |                 |          |        |    |        |   |    |         |   |   |                                                                                                                                                 |   |
| (iii)               | W                                                                                                                                                                                                                                                |                     | 1             |                 |          |        |    |        |   |    |         |   |   |                                                                                                                                                 |   |
| (iv)                | Y and Z                                                                                                                                                                                                                                          |                     | 1             |                 |          |        |    |        |   |    |         |   |   |                                                                                                                                                 |   |

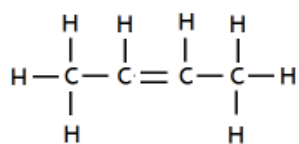
| Question number | Answer                                                                                                                                                                                                                                                                                                                                                                                                        | Notes                                                                                                                                                                                                                                                                                                                                    | Marks                           |
|-----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------|
| 2 (c)           | <ul style="list-style-type: none"> <li>sum of masses multiplied by percentages</li> <li>division by 100</li> <li>answer given to 1 decimal place</li> </ul> <p>Example calculation</p> <p><b>M1</b> <math>(91.2 \times 20) + (8.80 \times 22)</math> <b>OR</b> 2017.6</p> <p><b>M2</b> <math>2017.6 \div 100</math> <b>OR</b> 20.176</p> <p><b>M3</b> 20.2 <b>OR</b> answer from <b>M2</b> given to 1d.p.</p> | <p>Correct answer of 20.2 with or without working scores 3</p> <p><b>ACCEPT</b> 2018</p> <p><b>ACCEPT</b> 20.18</p> <p>correct answer without working scores 3</p> <p>20.176 and 20.18 without working score 2</p> <p>2020 scores <b>M1</b> and <b>M3</b></p> <p>20 without working scores 0</p> <p>20 with correct working scores 2</p> | <p>3</p> <p><b>Total 11</b></p> |

| Question number | Answer                                                                                                                                         | Notes                                                       | Marks          |
|-----------------|------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------|----------------|
| 3 (a) (i)       | diffusion                                                                                                                                      |                                                             | 1              |
| (ii)            | Any two from<br>M1 stir (the mixture)<br>M2 heat (the mixture)<br>M3 grind the sugar or break into smaller pieces or increase its surface area | ALLOW shake/swirl<br><br>ALLOW any description of heating   | 2              |
| (b) (i)         | (simple) distillation                                                                                                                          | REJECT fractional distillation<br>ALLOW distilling<br>OWTTE | 1              |
| (ii)            | An explanation that links the following two points<br>M1 (water/ vapour/ steam / gas) is cooled<br>M2 and condenses OR in the condenser        |                                                             | 2              |
|                 |                                                                                                                                                |                                                             | <b>Total 6</b> |

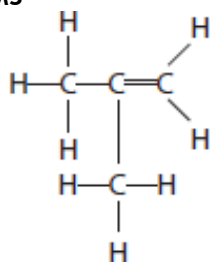
| Question number | Answer                                                                                                                                                                                                                                                                                                                                                                                                          | Notes                                                                                                                                                       | Marks    |
|-----------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|
| 4 (a) (i)       | <p>A description including any three of the following</p> <p>M1 pour some solvent into a beaker /chromatography tank</p> <p>M2 place the paper in the solvent so that the food colourings are above the level of the solvent</p> <p>M3 leave the paper until the solvent reaches the level shown in the diagram/ has moved to near the top of the paper OWTTE</p> <p>M4 take the paper out and leave to dry</p> | <p>M1 and M2 can be scored from a labelled diagram</p> <p>ALLOW any named solvent</p>                                                                       | 3        |
| (ii)            | one/1                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                                             | 1        |
| (iii)           | (F/it is) insoluble (in the solvent)/ does not dissolve (in the solvent)                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                                             | 1        |
| (iv)            | <p>M1 E and H</p> <p>M2 they contain a dye that moved the furthest (distance up the paper)/ is closest to the solvent front / has the greatest <math>R_f</math> value</p>                                                                                                                                                                                                                                       | <p>M2 dep on M1</p>                                                                                                                                         | 2        |
| (b)             | <p>M1 distance moved by solvent = 59-61mm and distance moved by the dye = 37-41mm</p> <p>M2 distance moved by the dye <math>\div</math> distance moved by the solvent <math>\approx</math> 0.67</p> <p>M3 (the dye in food colouring) G</p>                                                                                                                                                                     | <p>ALLOW distances in cm e.g. 6cm and 4cm</p> <p>If paper has been printed on A4 distances will be 51-53mm and 33-37mm</p> <p>ALLOW alternative methods</p> | 3        |
|                 |                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                             | Total 10 |

| Question number   | Answer                                                                                                                                                                                                                                                                                   | Notes                                              | Marks                         |      |        |                   |                 |                   |                                                          |                                              |   |
|-------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------|-------------------------------|------|--------|-------------------|-----------------|-------------------|----------------------------------------------------------|----------------------------------------------|---|
| 5 (a) (i)         | <table><tr><td>molecular formula</td><td>C<sub>2</sub>H<sub>6</sub></td></tr><tr><td>name</td><td>ethane</td></tr><tr><td>empirical formula</td><td>CH<sub>3</sub></td></tr><tr><td>displayed formula</td><td><pre>  H   H         H - C - C - H           H   H</pre></td></tr></table> | molecular formula                                  | C <sub>2</sub> H <sub>6</sub> | name | ethane | empirical formula | CH <sub>3</sub> | displayed formula | <pre>  H   H         H - C - C - H           H   H</pre> | Penalise incorrect use of case, superscripts | 3 |
| molecular formula | C <sub>2</sub> H <sub>6</sub>                                                                                                                                                                                                                                                            |                                                    |                               |      |        |                   |                 |                   |                                                          |                                              |   |
| name              | ethane                                                                                                                                                                                                                                                                                   |                                                    |                               |      |        |                   |                 |                   |                                                          |                                              |   |
| empirical formula | CH <sub>3</sub>                                                                                                                                                                                                                                                                          |                                                    |                               |      |        |                   |                 |                   |                                                          |                                              |   |
| displayed formula | <pre>  H   H         H - C - C - H           H   H</pre>                                                                                                                                                                                                                                 |                                                    |                               |      |        |                   |                 |                   |                                                          |                                              |   |
| (ii)              | $2\text{C}_2\text{H}_6 + 7\text{O}_2 \rightarrow 4\text{CO}_2 + 6\text{H}_2\text{O}$                                                                                                                                                                                                     | ACCEPT multiples and fractions                     | 1                             |      |        |                   |                 |                   |                                                          |                                              |   |
| (iii)             | Any two from<br>M1 carbon monoxide/CO<br>M2 carbon/C<br>M3 water (vapour)/steam/H <sub>2</sub> O                                                                                                                                                                                         | ALLOW soot<br>IGNORE carbon dioxide                | 2                             |      |        |                   |                 |                   |                                                          |                                              |   |
| (b) (i)           | A addition<br><br>B is incorrect as it is not a decomposition reaction<br>C is incorrect as no solid precipitate is produced<br>D is incorrect as it is not a substitution reaction                                                                                                      |                                                    | 1                             |      |        |                   |                 |                   |                                                          |                                              |   |
| (ii)              | Any two from<br>M1<br><pre>  H   H   H   H                 H - C = C - C - C - H                   H   H</pre>                                                                                                                                                                           | Do not accept displayed formulae of cyclic alkanes | 2                             |      |        |                   |                 |                   |                                                          |                                              |   |

M2



M3



(iii) isomers

**ALLOW** cis-trans (E/Z)  
isomers of but-2-ene for  
both marks

**ALLOW** isomerism

1

| Question number | Answer                                                                                                                                                                                                                                                       | Notes                                                 | Marks    |
|-----------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------|----------|
| 5 (c) (i)       | $\left[ \begin{array}{cc} \text{H} & \text{CH}_3 \\   &   \\ -\text{C} & -\text{C}- \\   &   \\ \text{H} & \text{H} \end{array} \right]_n$ <p><b>M1</b> correct repeat unit</p> <p><b>M2</b> extension bonds, brackets and n after brackets</p>              | <p>If double bond between carbon atoms scores 0</p>   | 2        |
| (ii)            | <p>A discussion which refers to the following points</p> <p><b>M1</b> polymers/poly(propene) will remain in landfill indefinitely OWTTE</p> <p><b>M2</b> (as they) are inert /unreactive/do not biodegrade</p> <p><b>M3</b> burning produces toxic gases</p> | <p><b>ALLOW</b> burning produces greenhouse gases</p> | 3        |
|                 |                                                                                                                                                                                                                                                              |                                                       | Total 15 |

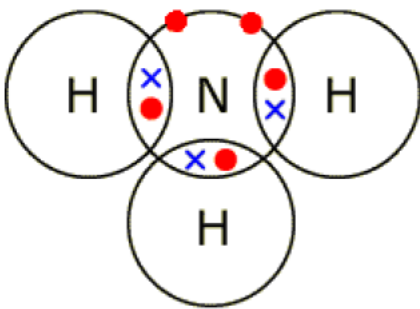
| Question number | Answer                                                                                                                                                                                                                                                | Notes                                                                                                                               | Marks |
|-----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------|-------|
| 6 (a) (i)       | Any 3 from<br>M1 effervescence/bubbles/fizzing<br>M2 moves<br>M3 floats<br>M4 disappears/gets smaller<br>M5 vapour trail/steam                                                                                                                        | moves on surface<br>scores M2 and M3<br><br>ALLOW dissolves<br><br>IGNORE melts/heat produced<br>IGNORE any reference to indicators | 3     |
| (ii)            | An explanation that links the following two points<br><br>M1 the universal indicator turns purple/blue<br>M2 (because) OH <sup>-</sup> /hydroxide ions are present                                                                                    | <br><br>ALLOW an alkaline solution /an alkali is produced / a solution of high pH is formed                                         | 2     |
| (iii)           | $2\text{Li} + 2\text{H}_2\text{O} \rightarrow 2\text{LiOH} + \text{H}_2$<br><br>M1 all formulae correct<br>M2 balancing of correct formulae                                                                                                           | ALLOW multiples and fractions<br><br>M2 dep on M1                                                                                   | 2     |
| (b) (i)         | An explanation that links the following two points<br><br>M1 to remove any other ions/chemicals/ impurities/ contaminants/ compounds/substances (that may be on the wire)<br><br>M2 (so that) they do not interfere with/mask the colour of the flame | <br><br>ALLOW (so that) they do not affect the result (of the test)<br>ALLOW (remove substances) that could colour the flame        | 2     |

|      |                                                                                                                                                                                                               |  |   |
|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|---|
| (ii) | <p><b>D</b> yellow</p> <p>A is incorrect as sodium ions do not give a green flame<br/> B is incorrect as sodium ions do not give a lilac flame<br/> C is incorrect as sodium ions do not give a red flame</p> |  | 1 |
|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|---|

| Question number | Answer                                                                                                                                                                                                                                                                                                                                                                                     | Notes                               | Marks           |
|-----------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------|-----------------|
| 6 (c) (i)       | $K^+$ and $SO_4^{2-}$                                                                                                                                                                                                                                                                                                                                                                      |                                     | 1               |
| (ii)            | <p>An explanation that links the following four points</p> <p><b>M1</b> (potassium sulfate) has a giant (ionic) structure /lattice</p> <p><b>M2</b> electrostatic attraction between oppositely charged ions</p> <p><b>M3</b> (ionic bonds or forces / attractions between ions) are strong</p> <p><b>M4</b> a large amount of energy is needed to overcome the forces/break the bonds</p> | ionic bonds are strong<br>scores M3 | 4               |
|                 |                                                                                                                                                                                                                                                                                                                                                                                            |                                     | <b>Total 15</b> |

| Question number                            | Answer                                                                                                                                                                                                        | Notes                                      | Marks |                                   |      |                        |      |                                               |   |
|--------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------|-------|-----------------------------------|------|------------------------|------|-----------------------------------------------|---|
| 7 (a) (i)                                  | → magnesium chloride + hydrogen                                                                                                                                                                               | ACCEPT in either order                     | 1     |                                   |      |                        |      |                                               |   |
| (b) (i)                                    | <table><tr><td>temperature of the acid at the start in °C</td><td>22.4</td></tr><tr><td>highest temperature reached in °C</td><td>43.2</td></tr><tr><td>temperature rise in °C</td><td>20.8</td></tr></table> | temperature of the acid at the start in °C | 22.4  | highest temperature reached in °C | 43.2 | temperature rise in °C | 20.8 | ALLOW ECF from incorrect starting temperature | 2 |
| temperature of the acid at the start in °C | 22.4                                                                                                                                                                                                          |                                            |       |                                   |      |                        |      |                                               |   |
| highest temperature reached in °C          | 43.2                                                                                                                                                                                                          |                                            |       |                                   |      |                        |      |                                               |   |
| temperature rise in °C                     | 20.8                                                                                                                                                                                                          |                                            |       |                                   |      |                        |      |                                               |   |

| Question number | Answer                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Notes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Marks          |
|-----------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|
| 7               | (ii) <ul style="list-style-type: none"> <li>substitute correct values into <math>Q = mc\Delta T</math></li> <li>evaluation</li> </ul> <p>Example calculation</p> <p><b>M1</b> <math>Q = 25 \times 4.2 \times 20.8</math></p> <p><b>M2</b> 2184 (J)</p>                                                                                                                                                                                                                                                                                                 | Correct answer of 2184 or 2194 without working scores 2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 2              |
|                 | (iii) <ul style="list-style-type: none"> <li>find the amount of magnesium in moles</li> <li>divide <math>Q</math> by <math>n</math></li> <li>convert answer in J/mol to kJ/mol</li> <li>answer including sign</li> </ul> <p>Example calculation</p> <p><b>M1</b> <math>n(\text{Mg}) = 0.12 \div 24</math> <b>OR</b> 0.005(0)</p> <p><b>M2</b> <math>Q \div n</math> <b>OR</b> <math>2184 \div 0.005(0)</math> <b>OR</b> 436,800 (J/mol)</p> <p><b>M3</b> <math>436,800 \div 1000</math> <b>OR</b> 436.8 (kJ/mol)</p> <p><b>M4</b> – 436.8 (kJ/mol)</p> | <p><b>ALLOW</b> 25.12g for <math>m</math></p> <p><b>ACCEPT</b> any number of sig figs except 1<br/><b>ALLOW</b> ECF from M1</p> <p><b>ACCEPT</b> use of 2180 or 2200</p> <p><b>ALLOW</b> ECF on incorrect answer to (ii) and/or <b>M1</b></p> <p><b>ALLOW</b> ECF on incorrect answer to <b>M2</b></p> <p><b>ALLOW</b> ECF on incorrect answer to <b>M3</b></p> <p>Correct answer with minus sign and without working scores 4</p> <p>Correct answer without minus sign and without working scores 3</p> <p><b>ACCEPT</b> any number of sig figs except 1 throughout (ii)</p> <p>-438.8 or -438.9 also scores 4 (from 5.12g and 2194J in (ii))</p> | 4              |
|                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | <b>Total 9</b> |

| Question number | Answer                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Notes                                                                                                                                                                                                          | Marks |
|-----------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| 8 (a)           | <p>A description which refers to the following six points</p> <p>Test for ammonium ions:</p> <p>M1 add sodium hydroxide (solution) (and warm)</p> <p>M2 test the gas with (damp) (red) litmus paper / (damp) universal indicator paper</p> <p>M3 (litmus) turns blue / (universal indicator) turns blue/purple (if ammonium ions are present)</p> <p>Test for sulfate ions:</p> <p>M4 add (dilute hydrochloric/nitric) acid</p> <p>M5 add barium chloride (solution) / barium nitrate (solution)</p> <p>M6 white precipitate (if sulfate ions are present)</p> | <p>ALLOW other alkalis</p> <p>No M2 or M3 if solution tested with litmus / universal indicator paper</p> <p>M4 and M5 can be in either order</p> <p>No M4 or M6 if sulfuric acid added</p> <p>M6 dep on M5</p> | 6     |
| (b) (i)         | neutralisation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | ALLOW acid-base OR acid-alkali                                                                                                                                                                                 | 1     |
| (ii)            | $2\text{NH}_3 + \text{H}_2\text{SO}_4 \rightarrow (\text{NH}_4)_2\text{SO}_4$                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | ALLOW multiples                                                                                                                                                                                                | 1     |
| (iii)           | <p>M1 3 bonding pairs correct</p> <p>M2 rest of molecule correct</p>                                                                                                                                                                                                                                                                                                                                                                                                        | <p>M2 dep on M1</p> <p>ALLOW any combination of dots and crosses</p>                                                                                                                                           | 2     |
| Total 10        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                |       |

| Question number | Answer                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Notes                                                                                                                                                                                                                                        | Marks |
|-----------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| 9 (a) (i)       | carbon dioxide/a gas is given off/escapes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | REJECT incorrect gas                                                                                                                                                                                                                         | 1     |
| (ii)            | to prevent acid/ liquid/ solution/ spray from leaving the flask OWTTE                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                                                                                                                                                                              | 1     |
| (iii)           | An explanation that links two of the following<br>M1 (insoluble) calcium sulfate will form<br>M2 which will form a coating/ layer on the marble chips<br>M3 slowing down/ preventing/ stopping the reaction                                                                                                                                                                                                                                                                                                                                                                 | M3 dep on M1 or M2                                                                                                                                                                                                                           | 2     |
| (b) (i)         | An explanation that links the following four points<br>M1 the curve is steep(est) at the start<br>M2 because the (acid) concentration is high(est)<br>M3 the curve becomes less steep as the solution/ acid is becoming more dilute<br>M4 the curve levels off/ stops going up when the acid has all been used up<br><br>OR<br>M1 the curve is steep(est) at the start<br>M2 because the reaction is fast(est) at the start<br>M3 the curve becomes less steep because the reaction slows down<br>M4 the curve levels off/stops going up when the acid has all been used up | ALLOW there are the most (acid) particles in solution<br><br>ALLOW the curve becomes less steep as there are fewer acid particles/particles in solution<br><br>IGNORE references to particles of marble chips<br>IGNORE references to energy | 4     |

|      |                                                                                                                                           |  |   |
|------|-------------------------------------------------------------------------------------------------------------------------------------------|--|---|
| (ii) | <p>M1 curve drawn starting at the origin and below the original curve</p> <p>M2 curve levels off at 0.27 g + or – half a small square</p> |  | 2 |
|------|-------------------------------------------------------------------------------------------------------------------------------------------|--|---|

| Question number | Answer                                                                                                                                                                                                                                                                                                                                                                                                                                                            | Notes                                                                                   | Marks                           |
|-----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------|---------------------------------|
| 9 (c)           | <p>An explanation that links the following four points</p> <p><b>M1</b> the rate of reaction increases/ the reaction is faster/ the reaction speeds up</p> <p>and any three from</p> <p><b>M2</b> because the particles gain (kinetic) energy /move faster</p> <p><b>M3</b> there are more collisions per unit time</p> <p><b>M4</b> more collisions/particles have energy greater than the activation energy</p> <p><b>M5</b> more collisions are successful</p> | <p>there are more frequent successful collisions<br/>scores <b>M3</b> and <b>M5</b></p> | <p>4</p> <p><b>Total 14</b></p> |

| Question number | Answer                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | Notes                                                                                                                                                                                                               | Marks |
|-----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| 10 (a) (i)      | so that the (hot) lead does not react with oxygen/air (converting back into lead oxide)                                                                                                                                                                                                                                                                                                                                                                                                                           | ACCEPT so that lead is not oxidised (back to lead oxide)                                                                                                                                                            | 1     |
| (ii)            | M1 repeat the heating<br>M2 until the mass remains constant/ does not change                                                                                                                                                                                                                                                                                                                                                                                                                                      | ACCEPT heat to constant mass for both marks                                                                                                                                                                         | 2     |
| (b) (i)         | 4.66 (g)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                     | 1     |
| (ii)            | 0.48 (g)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                     | 1     |
| (iii)           | <ul style="list-style-type: none"> <li>calculate the moles of lead and oxygen</li> <li>divide by the smaller number</li> <li>calculate the whole number ratio</li> <li>give the empirical formula</li> </ul> <p>Example calculation</p> <p>M1 <math>\frac{4.66}{207}</math> and <math>\frac{0.48}{16}</math> OR 0.0225 and 0.03(00)</p> <p>M2 <math>\frac{0.0225}{0.0225}</math> and <math>\frac{0.03(00)}{0.0225}</math> OR 1:1.33</p> <p>M3 1 x 3 and 1.33 x 3 OR 3:4</p> <p>M4 Pb<sub>3</sub>O<sub>4</sub></p> | <p>Division by atomic numbers or upside down calculation scores 0</p> <p>3:4 ratio without working scores 3</p> <p>Pb<sub>3</sub>O<sub>4</sub> without working scores 4</p> <p>ALLOW ECF from incorrect masses.</p> | 4     |

| Question number | Answer                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Notes                                                                                                                                                                                                                                                               | Marks           |
|-----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| 10 (c) (i)      | $\text{Pb}(\text{NO}_3)_2 (\text{aq}) + 2\text{HCl} (\text{aq}) \rightarrow \text{PbCl}_2 (\text{s}) + 2\text{HNO}_3 (\text{aq})$                                                                                                                                                                                                                                                                                                                                         | <b>ALLOW</b> any combination of uppercase and lowercase letters                                                                                                                                                                                                     | 1               |
| (ii)            | <ul style="list-style-type: none"> <li>calculate the amount of <math>\text{PbCl}_2</math></li> <li>multiply the moles by the <math>M_r</math> of <math>\text{PbCl}_2</math></li> <li>evaluation to show that the value is about 5 g</li> </ul> <p>Example calculation</p> <p><b>M1</b> <math>n(\text{PbCl}_2) = \frac{0.0370}{2}</math> <b>OR</b> 0.0185 (mol)</p> <p><b>M2</b> mass of <math>\text{PbCl}_2 = 0.0185 \times 278</math> (g)</p> <p><b>M3</b> 5.143 (g)</p> | <p><b>MAX 1</b> for <math>0.0370 \times 278</math> if no division by 2 in <b>M1</b></p> <p><b>ALLOW</b> any number of sig figs</p> <p>5.1, 5.14 and 5.143 g without working score 3</p> <p>5 g without working scores 0</p> <p><b>ALLOW</b> alternative methods</p> | 3               |
|                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                                                                                                                                                     | <b>Total 13</b> |

