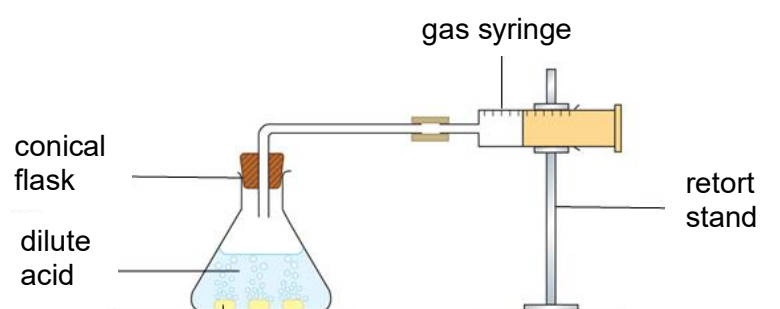


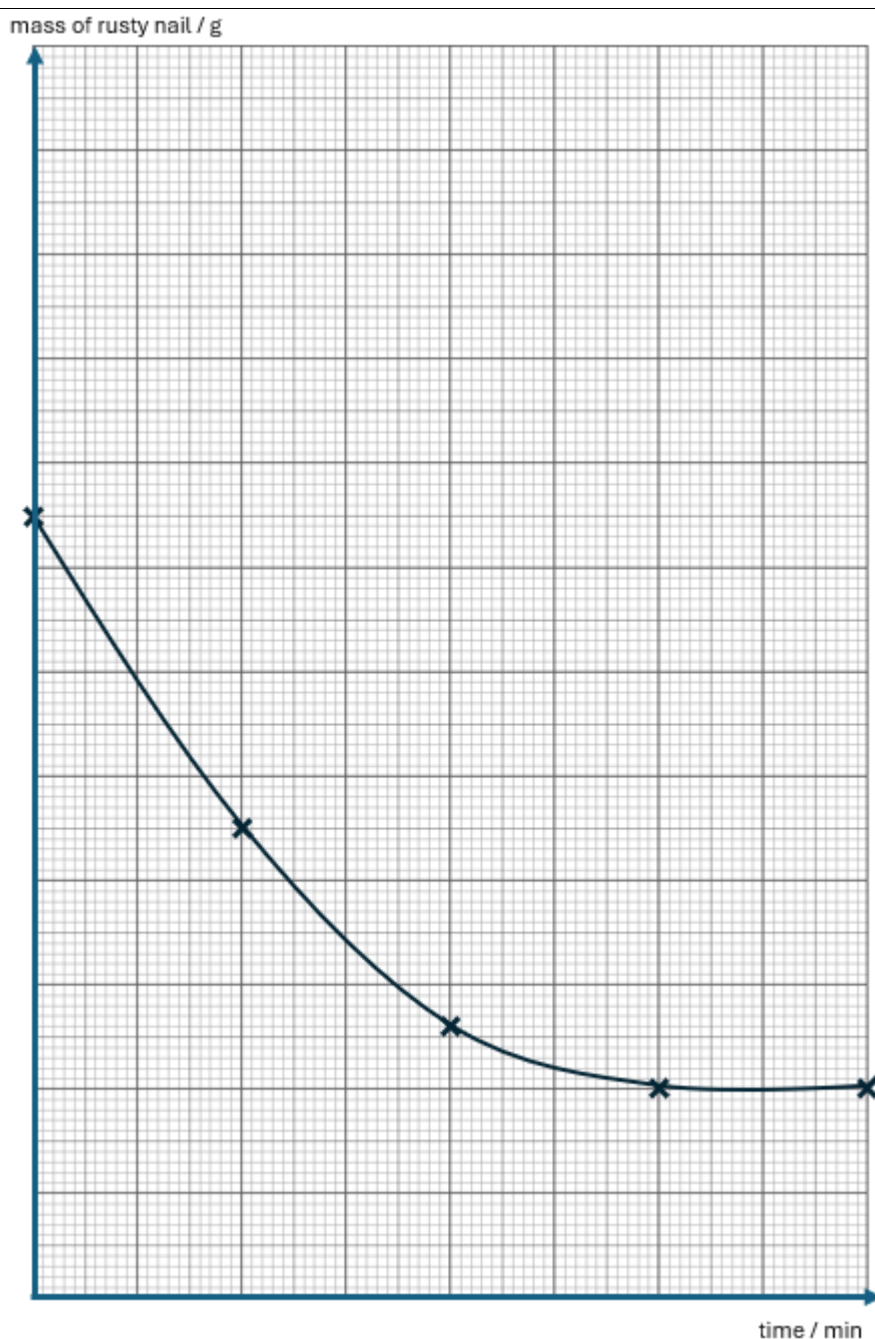
### Marking Scheme

#### Paper 3 6092/03

|                                           |     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                  |     |   |   |   |                                         |  |  |  |                                           |  |  |  |                                           |  |  |  |                            |  |  |
|-------------------------------------------|-----|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|-----|---|---|---|-----------------------------------------|--|--|--|-------------------------------------------|--|--|--|-------------------------------------------|--|--|--|----------------------------|--|--|
| 1ai                                       | PDO | <i>Results table:</i><br><br>Records initial burette readings, final burette readings and volume added with correct headings and units in a titration table<br><br>All burette readings for all accurate titres in titration table are recorded to <b>nearest 0.05 cm<sup>3</sup></b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | T<br>1           | [5] |   |   |   |                                         |  |  |  |                                           |  |  |  |                                           |  |  |  |                            |  |  |
|                                           | MMO | <i>Titration results</i><br>Accuracy<br>For the average titre (of consistent readings) within 0.20 cm <sup>3</sup> of supervisor's average value score 2 marks<br>For the average titre (of consistent readings) within 0.30 cm <sup>3</sup> of supervisor's average value score 1 marks<br><br>Concordance<br>At least two titre values are within 0.20 cm <sup>3</sup> (using uncorrected titres)<br><br>(teacher's result) <table><tr><td>Titration number</td><td>1</td><td>2</td><td>3</td></tr><tr><td>Final burette reading / cm<sup>3</sup></td><td></td><td></td><td></td></tr><tr><td>Initial burette reading / cm<sup>3</sup></td><td></td><td></td><td></td></tr><tr><td>Volume of <b>Q</b> used / cm<sup>3</sup></td><td></td><td></td><td></td></tr><tr><td>Best titration results (✓)</td><td></td><td></td><td></td></tr></table> | Titration number |     | 1 | 2 | 3 | Final burette reading / cm <sup>3</sup> |  |  |  | Initial burette reading / cm <sup>3</sup> |  |  |  | Volume of <b>Q</b> used / cm <sup>3</sup> |  |  |  | Best titration results (✓) |  |  |
| Titration number                          | 1   | 2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | 3                |     |   |   |   |                                         |  |  |  |                                           |  |  |  |                                           |  |  |  |                            |  |  |
| Final burette reading / cm <sup>3</sup>   |     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                  |     |   |   |   |                                         |  |  |  |                                           |  |  |  |                                           |  |  |  |                            |  |  |
| Initial burette reading / cm <sup>3</sup> |     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                  |     |   |   |   |                                         |  |  |  |                                           |  |  |  |                                           |  |  |  |                            |  |  |
| Volume of <b>Q</b> used / cm <sup>3</sup> |     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                  |     |   |   |   |                                         |  |  |  |                                           |  |  |  |                                           |  |  |  |                            |  |  |
| Best titration results (✓)                |     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                  |     |   |   |   |                                         |  |  |  |                                           |  |  |  |                                           |  |  |  |                            |  |  |
| 1aii                                      | MMO | Appropriate average volume of <b>Q</b> in 2d.p. from closest titre values (titres should be identified either in the table by a tick, or in a calculation). <u>Teacher's result:</u> 19.5 – 20.5 cm <sup>3</sup>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 1                | [1] |   |   |   |                                         |  |  |  |                                           |  |  |  |                                           |  |  |  |                            |  |  |
| 1bi                                       | ACE | No of moles of NaOH = 25/1000 x 0.0984 = <u>0.00246 mol</u>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 1                | [1] |   |   |   |                                         |  |  |  |                                           |  |  |  |                                           |  |  |  |                            |  |  |
| 1bii                                      | ACE | Concentration, in mol/dm <sup>3</sup> , of H <sub>3</sub> PO <sub>3</sub> in <b>Q</b><br>= 5.04 / 82<br>= 0.061463 mol/dm <sup>3</sup><br>= <u>0.0615 mol/dm<sup>3</sup></u>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 1<br><br>1       | [2] |   |   |   |                                         |  |  |  |                                           |  |  |  |                                           |  |  |  |                            |  |  |
| 1biii                                     | ACE | No of moles of H <sub>3</sub> PO <sub>3</sub> in 20.1 cm <sup>3</sup> of <b>Q</b><br>= [1aii] / 1000 x 0.061463<br>= <b>x</b> mol<br><br>Since no of moles of NaOH that reacted = 0.00246 mol,<br>No of moles of sodium hydroxide that react with 1 mole of H <sub>3</sub> PO <sub>3</sub><br>= 0.00246 / <b>x</b><br>= 2.00 mol (Accept: 1.95 – 2.05)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 1<br><br><br>1   | [2] |   |   |   |                                         |  |  |  |                                           |  |  |  |                                           |  |  |  |                            |  |  |
| 1biv                                      | ACE | 2 NaOH + H <sub>3</sub> PO <sub>3</sub> → Na <sub>2</sub> HPO <sub>3</sub> + 2 H <sub>2</sub> O                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 1                | [1] |   |   |   |                                         |  |  |  |                                           |  |  |  |                                           |  |  |  |                            |  |  |
| 1c                                        | MMO | Repeat the titration <u>without the indicator</u> , <u>using 25.0cm<sup>3</sup> of P and the volume of Q found in (a)(ii).</u><br><br>Transfer the salt solution produced to an evaporating dish.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | 1<br><br>1       | [3] |   |   |   |                                         |  |  |  |                                           |  |  |  |                                           |  |  |  |                            |  |  |

|              |            |                                                                                                                                                                                                                                                                         |                    |            |
|--------------|------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|------------|
|              |            | Heat the salt solution until <u>saturated solution is formed</u> .<br><u>Cool the solution</u> to allow crystallisation.                                                                                                                                                |                    |            |
|              |            | Filter to obtain crystals, wash with cool distilled water and <u>pat dry</u> crystals with filter paper.                                                                                                                                                                | 1                  |            |
| <b>1d</b>    | ACE        | There would be <u>no change</u> to the titration results.                                                                                                                                                                                                               |                    | <b>[2]</b> |
|              |            | $M_r$ of $H_2SO_3$ is also 82 / the mole <u>concentration of the acid is the same as</u> $H_3PO_3$                                                                                                                                                                      | 1                  |            |
|              |            | <i>Accept calculations to show that the mole concentration is the same.</i>                                                                                                                                                                                             |                    |            |
|              |            | <u>Number of moles</u> of hydroxide that react with 1 mole of $H_2SO_3$ <u>is the same</u> as that of $H_3PO_3$ / the number of moles of $H_2SO_3$ <u>required for neutralisation</u> is the same as that of $H_3PO_3$ .                                                | 1                  |            |
|              |            |                                                                                                                                                                                                                                                                         | <b>[Total: 17]</b> |            |
| <b>2ai</b>   | MMO<br>PDO | Any <b>TWO</b> from below <ul style="list-style-type: none"> <li>effervescence, gas forms a white precipitate when bubbled into limewater</li> <li>solid dissolves to form a colourless solution</li> <li>solution becomes warm</li> </ul>                              | 2                  | <b>[2]</b> |
| <b>2aii</b>  | MMO<br>PDO | White precipitate forms<br>Dissolves in excess to form a colourless solution                                                                                                                                                                                            | 1<br>1             | <b>[2]</b> |
| <b>2aiii</b> | MMO<br>PDO | Any <b>TWO</b> from below <ul style="list-style-type: none"> <li><input type="checkbox"/> solid turns yellow</li> <li><input type="checkbox"/> condensation/ water droplets at top of tube</li> <li><input type="checkbox"/> turns white again (when cooled)</li> </ul> | 2                  | <b>[2]</b> |
| <b>2aiv</b>  | ACE        | Carbon dioxide                                                                                                                                                                                                                                                          | 1                  | <b>[1]</b> |
| <b>2av</b>   | ACE        | Zinc and / or aluminium (ions) give the same result                                                                                                                                                                                                                     | 1                  | <b>[1]</b> |
| <b>2avi</b>  | ACE        | Add aqueous ammonia                                                                                                                                                                                                                                                     | 1                  | <b>[1]</b> |
| <b>2bi</b>   | MMO<br>PDO | White precipitate forms                                                                                                                                                                                                                                                 | 1                  | <b>[1]</b> |
| <b>2bii</b>  | MMO<br>PDO | White precipitate forms                                                                                                                                                                                                                                                 | 1                  | <b>[1]</b> |
| <b>2biii</b> | MMO<br>PDO | White precipitate forms<br>Insoluble in excess                                                                                                                                                                                                                          | 1<br>1             | <b>[2]</b> |
| <b>2biv</b>  | ACE        | Calcium chloride / $CaCl_2$                                                                                                                                                                                                                                             | 1                  | <b>[3]</b> |
|              |            | From (b)(ii), white precipitate formed with acidified silver nitrate shows presence of chloride ions.                                                                                                                                                                   | 1                  |            |
|              |            | From (b)(iii), white precipitate that is insoluble in excess sodium hydroxide shows the presence of calcium ions.                                                                                                                                                       | 1                  |            |
|              |            | (Evidence must specify the test itself)                                                                                                                                                                                                                                 |                    |            |
|              |            |                                                                                                                                                                                                                                                                         | <b>[Total: 16]</b> |            |

|    |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |             |     |
|----|---|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|-----|
| 3a | P | <p><u>Labelled diagram</u></p>  <p>Procedure (accept lesser details if they can be complemented with the labelled diagram):</p> <ol style="list-style-type: none"> <li>1. Measure the mass of the rusty nail using an electronic balance, <math>M</math> g.</li> <li>2. Add the rusty nail into a conical flask and add <b>excess</b> dilute acid to the conical flask.</li> <li>3. Stopper the conical flask immediately with a delivery tube connected to a calibrated gas syringe.</li> <li>4. Measure the maximum volume of gas collected in the syringe, <math>V</math> cm<sup>3</sup>.</li> <li>5. Calculate the mass of rust using the following method:</li> </ol> <p><math display="block">\text{Fe} + 2\text{H}^+ \rightarrow \text{Fe}^{2+} + \text{H}_2</math></p> <p>No. of moles of hydrogen = <math>(V/24000)</math> mol<br/>         No. of moles of iron = <math>(V/24000)</math> mol<br/>         Mass of iron = <math>(V/24000) \times 56 = (7V/3000)</math> g<br/>         Mass of rust = <math>M - (7V/3000)</math> g</p> | 2           | [4] |
| 3b | P | <p>Correct scale<br/>                 Correct points plotted<br/>                 Correct line of best fit with all points</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 1<br>1<br>1 | [3] |



[Total: 7]