This mark scheme is published as an aid to teachers and candidates, to indicate the requirements of the examination. It shows the basis on which Examiners were instructed to award marks. It does not indicate the details of the discussions that took place at an Examiners' meeting before marking began, which would have considered the acceptability of alternative answers.

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1 (a) Titration

Accuracy 8 marks

For the two best titres give:
4 marks for a value within 0.2 cm$^3$ of supervisor
2 marks for a value within 0.3 cm$^3$ of supervisor
1 mark for a value within 0.4 cm$^3$ of supervisor

Concordance 3 marks

Give:
3 marks if all the ticked values are within 0.2 cm$^3$
2 marks if all the ticked values are within 0.3 cm$^3$
1 mark if all the ticked values are within 0.4 cm

Average 1 mark

Give 1 mark if the candidate calculates a correct average (error not greater than 0.05) of all his/her ticked values.

[12]

Assuming a 25.0 cm$^3$ pipette and a titre of 20.2 cm$^3$.

(b) moles of sodium hydroxide in 25 cm$^3$ of Q

\[
= \frac{25 \times 0.336}{1000}
\]

\[
= 0.0084
\]

[1]

(c) moles of hydrochloric acid reacting with 25 cm$^3$ of Q

\[
= 0.0084
\]

[1]

(d) moles of hydrochloric acid in 250 cm$^3$ of P

\[
= \frac{0.0084 \times 250}{20.2}
\]

\[
= 0.104
\]

[1]

(e) moles of hydrochloric acid in 250 cm$^3$ 0.500 mol/dm$^3$ acid

\[
= \frac{250 \times 0.5}{1000}
\]

\[
= 0.125
\]

[1]
(f) moles of hydrochloric acid that reacted with calcium carbonate

\[ \frac{0.125 - 0.104}{2} = 0.021 \]  

[1]

(g) mass of calcium carbonate in one tablet

\[ = \frac{0.021 \times 100}{2 \times 2} = 0.525 \text{ g} \]

If the answer from (f) undergoes any one of the following processes, score 1 mark
If answer from (f) undergoes all of the following processes, score 2 marks

(f)/2 mole of calcium carbonate

(f) \times 100 mass of calcium carbonate

(f)/2 moles in 1 tablet

[2]

[Total: 19]
2  **R** is dilute hydrochloric acid; **S** is manganese(IV) oxide

<table>
<thead>
<tr>
<th>Test</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>General points</strong></td>
<td></td>
</tr>
<tr>
<td>For precipitate/ppt</td>
<td>Allow solid, suspension, powder</td>
</tr>
<tr>
<td>For gases</td>
<td>Name of gas requires test to be at least partially correct. Effervesces = bubbles = gas vigorously evolved but not gas evolved.</td>
</tr>
<tr>
<td>Solutions</td>
<td>Colourless not equivalent to clear, clear not equivalent to colourless.</td>
</tr>
</tbody>
</table>

| Solution R | |
| Test 1 | white ppt (1) |
| Test 2 | insoluble in acid (1) |
| Test 3 | ppt dissolves (1) colourless solution (1) |
| Test 4 | (a) effervescence (1) turns limewater milky (1) carbon dioxide (1) solid disappears (1) To score carbon dioxide mark there must be some indication of a test e.g. ‘tested with lime water’ |
| (b) white ppt (1) ppt dissolves (1) colourless solution (1) |
| Test 5 | (a) white ppt (1) |
| (b) ppt disappears (1) |
## Test 6

| (a) | bubbles | (1) |
|     | relights a glowing splint | (1) |
|     | oxygen | (1) |

To score oxygen mark there must be some indication of a test e.g. ‘tested with a glowing splint’, ‘relights a (burning) splint’

## Test 7

| (a) | yellow/brown filtrate | (1) |
|     | liquid turns blue/black | (1) |

## Test 8

| litmus turns white/bleached | (1) |
| chlorine | (1) |

To score chlorine mark there must be some indication of the gas e.g. ‘smell of chlorine’

Any 19 out of 20 points to score.

**R** contains hydrochloric acid/hydrogen chloride/HCl (dependent on white ppt in test 1; insoluble in acid in test 2 or chlorine identified in test 8; and bubbling/gas in test 4) (1)

**S** is an oxidising agent/oxidant (dependent on indication of iodine in test 7 or chlorine in test 8) (1)

[Total: 21]