Question 31 (6 marks)

(a) A student collected a 250 mL sample of water from a local dam for analysis. The data collected are shown in the table.

<table>
<thead>
<tr>
<th>Mass of filter paper</th>
<th>0.23 g</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mass of filter paper and solid</td>
<td>0.47 g</td>
</tr>
<tr>
<td>Mass of evaporating basin</td>
<td>43.53 g</td>
</tr>
<tr>
<td>Mass of basin and solid remaining</td>
<td>44.67 g</td>
</tr>
</tbody>
</table>

(i) The water was filtered and the filtrate evaporated to dryness.

Calculate the percentage of the total dissolved solids in the dam sample.

\[
\text{TDS} = \frac{1.14 \ g}{4.56 \ L} \times \frac{4.56 \ L}{0.250 \ L} \times 100 = 46.56\%
\]

(ii) It is suspected that the water in the dam has a high concentration of chloride ions.

Describe a chemical test that could be carried out on the water sample to determine the presence of chloride ions. Include an equation in your answer.

\[
\text{AgNO}_3 + \text{Cl}^- \rightarrow \text{AgCl} + \text{NO}_3^- \]

\[
\text{net:} \quad \text{Ag}^+ + \text{Cl}^- \rightarrow \text{AgCl} \]

AgCl is insoluble and would thus indicate the presence of Cl. CO\(_3^{2-}\) also forms a precipitate with Ag, therefore add HNO\(_3\) to the solution to confirm. If the precipitate dissolves, then it is CO\(_3^{2-}\), but if it remains the Cl\(^-\) presence is confirmed.

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Question 31 (continued)

(b) Name an ion other than chloride that commonly pollutes waterways, and identify its source and the effect of its presence on water quality. 

Calcium ions (Ca$^{2+}$) are often found in waterways due to dissolution of limestone (CaCO$_3$). A high presence of Ca$^{2+}$ can make water to be hard and can prevent soap from dissolving.

End of Question 31

A common pollutant in waterways is SO$_4^{2-}$. This is sourced from farm run-offs as fertilisers contain SO$_4^{2-}$. This reacts with water to form sulphuric acid which can reduce the pH of water ways making it very difficult to treat, killing aquatic life and making it unpotable.