Question 28 (8 marks)

The flowchart shown outlines the sequence of steps used to determine the concentration of an unknown hydrochloric acid solution.

Describe steps A, B and C including correct techniques, equipment and appropriate calculations. Determine the concentration of the hydrochloric acid.

Step A: Weigh out accurately 5.3 g of sodium carbonate (Na₂CO₃). Add 20 mL of distilled water and stir with a stirring rod. Repeat 5-6 times or until all the Na₂CO₃ is dissolved. Transfer the solution to a pre-rinsed conical flask, ensuring the beaker is washed with a wash bottle several times to ensure all the Na₂CO₃ has been transferred. Add distilled water until the bottom of the meniscus hits the 500 mL mark. Now calculate the concentration of the sodium carbonate standard solution. molar = \( \frac{5.3 g}{22.989 g/mol \times \frac{1}{6}} = 0.05000 \)

\[ \frac{0.05000 \text{ moles}}{500 \text{ mL}} = 0.1000 \text{ moles/L} = 0.100 \text{ mol/L} \]

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Question 28 (continued)

For:

Rinse a conical flask with distilled water.

Step B – Place 25 ml of the standard solution in a conical flask and rinse the sides of the flask with distilled water.

Do the same with the pipette end.

Then draw out 25 ml of Na₂O₃ (aq) using the pipette end...

...and place in each conical flask. Wash the burette with distilled water and then hydrochloric acid (HCl). Then fill it up with HCl up to the etched mark. Place a suitable indicator in the conical flask and titrate. The reading should be a rough guide, but too be careful and release drop by drop to ensure a more accurate reading.

For the next three readings ensure there are no outliers in these three values before averaging them.

Titrations apparatus:

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End of Question 28

Step 8C – When the two react it does so accordingly:

\[
\text{Na}_2\text{O}_3 (aq) + 2\text{HCl} (aq) \rightarrow 2\text{NaCl} (aq) + \text{H}_2\text{O} (l) + \text{CO}_2 (g)
\]

\[
2.5 \times 10^{-3} \text{ moles of Na}_2\text{O}_3 = 0.100 \times 0.025 = 2.5 \times 10^{-3}
\]

\[
2.5 \times 10^{-3} \text{ moles of HCl} = 2 \times 2.5 \times 10^{-3} = 5 \times 10^{-3}
\]

\[
\frac{2}{5} \times 10^{-3} \text{ moles/L}
\]

\[
\frac{0.23364}{0.234} \text{ mol/L} = 0.234 \text{ mol/L}
\]