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 involves the process of preparing a standard solution. A standard solution is a solution created with a known volume, concentration, and total moles. The standard solution in this case is the sodium carbonate solution. Initially, one must weigh an amount of Na₂CO₃ by using an accurately calibrated electronic balance. This preweighed amount is then dissolved in a specific, accurately measured volume of water, and the preparation is completed by adding the solid powder and stoppering the cal cylinders to ensure complete dissolution. In this experiment, the mass of the standard can be calculated...
Question 28 (continued)

\[ \text{Step B: involves titrating an unknown concentration of HCl against the standard, with an appropriate indicator such as phenolphthalein blue, until a point where complete neutralisation is achieved. The standard is prepared from a known molar concentration and is stock solution of Na}_2\text{CO}_3. \]

\[ M(\text{Na}_2\text{CO}_3) \times n = m \quad m = 5.245 \text{ g of } \text{Na}_2\text{CO}_3 \text{ used in preparation of } \text{Na}_2\text{CO}_3 \text{ stock solution.} \]

\[ \text{End of Question 28} \]

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**Step C:**

Mathematically, the concentration of HCl titrated can be determined:

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

\[ n(\text{HCl}) = 2 \times 0.05 = 0.1 \text{ mol} \]

\[ C = \frac{A}{v} = \frac{0.1}{0.034} = 4.67 \text{ mol L}^{-1} \]