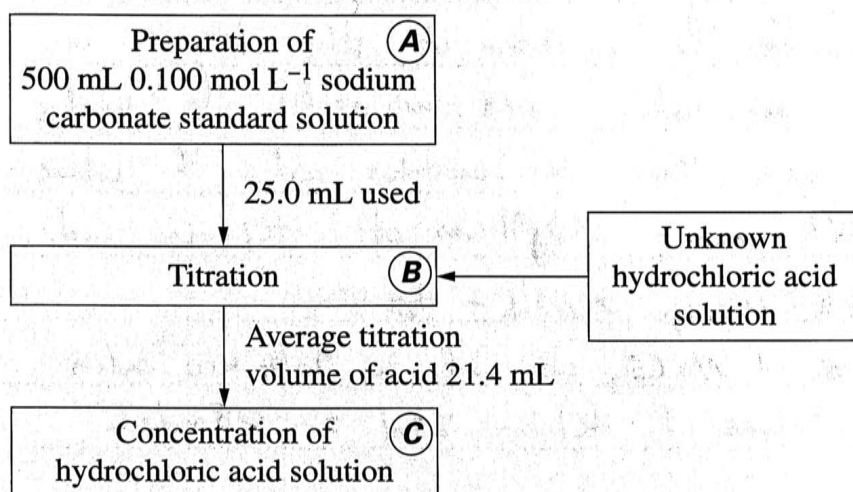**Question 28** (8 marks)

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

(8)

```
┌─────────────────────────────┐
│   Preparation of      (A)   │
│ 500 mL 0.100 mol L⁻¹ sodium │
│   carbonate standard solution│
└─────────────────────────────┘
              │ 25.0 mL used
              ▼
┌─────────────────────┐      ┌──────────────────┐
│   Titration    (B)  │◄─────│    Unknown        │
└─────────────────────┘      │ hydrochloric acid │
              │              │    solution       │
              │ Average titration└──────────────────┘
              │ volume of acid 21.4 mL
              ▼
┌─────────────────────────┐
│ Concentration of   (C)  │
│ hydrochloric acid solution│
└─────────────────────────┘
```

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

Ⓐ to prepare a standard solution of such low molarity
we dilute a more concentrated solution. $Na_2CO_3$ has a molar
weight of $22.99 + 12 + 3(16) = 82.99$ we would weigh out
$165.98g$ of sodium carbonate using a senior balance as
exactly as possible. As this would give us 2 moles of
sodium carbonate. dissolving 2 moles in 1L gives us 1L
of $1 mol L^{-1}$ solution if we take 50mL of this solution
which has been stirred thoroughly to ensure that it has
all dissolved and diluted it up to 500mL we
would then have 500ml of $\cdot 100 mL^{-1}$ sodium carbonate solution.
in volumetric flasks.

**Question 28 continues on page 18**

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Question 28 (continued)

(B) Weak base strong acid titration requires a indicator which will change at around 6 pH. First add a few drops of methyl orange to the HCl which shold be pipeted into a clean & beaker. The pipett shold be rinsed with HCl. Slowly add Sodium carbonate from the buret which has been rinsed with sodium carbonate until the indicator changes colour. repeat the titration for reliability of results.

(C) we calculate the concentration of HCl because we know how much sodium carbonate was needed to neutralise it and we know its concentration and the volume of the HCl. assuming 25 ~~dy~~ ml was of HCl was used.

$HCl_{aq} \rightarrow + 2 NaCO_{3 aq} \rightarrow NACl + H_2O HCO_3$
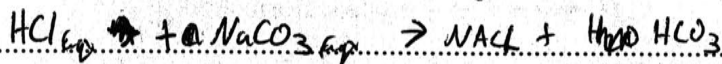
21.4 ~~mls~~ ml of $NaCO_3$ was used ie $2.14 \times 10^{-3}$ moles

$\therefore 2.14 \times 10^{-3}$ moles of HCl in 25ml $= .08 mols L^{-1}$

**End of Question 28**