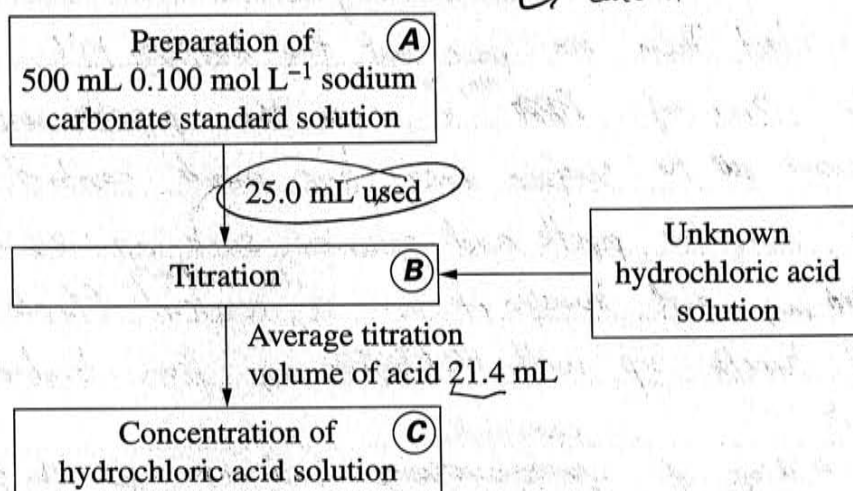


Question 28 (8 marks)

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

8



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

Step **A**, requires the preparation of a standard solution.

$$\begin{aligned} \text{Moles of } (\text{Na}_2\text{CO}_3) &= 0.5 \times 0.1 \\ &= 0.05 \text{ moles} = 5.2995 \text{ g} \end{aligned}$$

1) Using an electronic balance, weigh out 5.2995g of Na_2CO_3 solid on a watch glass.

2) Now using a funnel, transfer the solid into a 500mL volumetric flask, use distilled water washer bottle to rinse all remaining particles from the funnel and watch glass into the volumetric flask.

3) Now tightly swirl the volumetric flask until the solid dissolves completely.

Question 28 continues on page 18

4) Fill the volumetric flask up to the 500mL mark with distilled water. Ensure that the bottom meniscus ~~touches~~ touches the line.

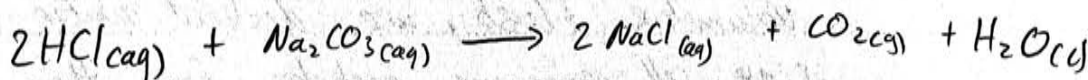
5) Place a stopper on the top of the flask.

Question 28 (continued)

Step B.

- 1). Transfer 100 mL of the Na_2CO_3 standard into a dry and clean beaker, label it.
- 2). Do this for the unknown HCl(aq) into another clean and dry beaker, label it.
- 3). Using 10 mL of ~~NaOH~~ HCl from the beaker, rinse the burette ensuring all the surface area has made contact. Then ~~pour out the NaOH~~ HCl .
- 4). Use 10 mL of ~~NaOH~~ Na_2CO_3 to rinse the pipette and ensure all the surface area has made contact. Then pour out.
- 5). Now using the pipette and splunder, suck up 2.5 mL of ~~NaOH~~ Na_2CO_3 and transfer it to a ~~clean and dry~~ conical flask.
- 6). Fill burette up with ~~NaOH~~ HCl(aq) from beaker up to 0 mL mark.
- 7). Add 5 drops of ~~metaphosphoric~~ phenolphthalein indicator to the conical flask.
- 8). ~~Titrate~~ Slowly add drops of ~~NaOH~~ HCl to the conical flask until you observe a colour change, then you have reached your equivalence point.
- 9). Record the mL used of ~~NaOH~~ HCl into a table. The first run, is your rough, remember to omit from average taken.
- 10). ~~Repeat the titration~~ clean and dry the conical flask before repeating experiment 5 times.
- 11). Average your results, omitting outliers and first rough titration.
- 12). Calculate the concentration of unknown, using average.

Step C.



Average titration (HCl) = 21.4 mL

$$\text{Moles of } (\text{Na}_2\text{CO}_3) = 0.025 \times 0.1$$

$$= 0.0025 \text{ moles}$$
Since $\text{HCl} : \text{Na}_2\text{CO}_3 \Rightarrow 2:1$ \therefore moles of HCl = 0.005 moles

Thus,

$$\text{Conc. HCl} = \frac{0.005 \text{ moles}}{0.0214}$$

$$= 0.2336448598 \text{ mol L}^{-1}$$

$$\approx 0.234 \text{ mol L}^{-1} \text{ (3sf)}$$