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[Total: 10]

- 2 (a) Volhard's method is a common method used to determine the concentration of chloride ions in a given solution.

A contaminated sample **X** contains sodium chloride and sodium carbonate, and other unknown impurities.

Part 1: Determination of percentage mass of sodium carbonate

0.500 grams of **X** was dissolved in water and made up to a 250 cm³ solution.

25.0 cm³ of solution was withdrawn into a conical flask, and titrated against a standard solution of 0.0500 mol dm⁻³ hydrochloric acid, with the indicator being methyl orange.

Some data concerning carbonic acid, H₂CO₃, is shown below:

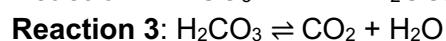
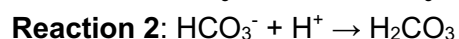
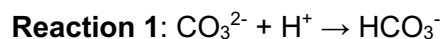
$$pK_1 = 6.35$$

$$pK_2 = 10.33$$

The results were tabulated as follows:

Titre no.	1	2
Volume of HCl used / cm ³	15.30	15.40

In the titrations, 3 reactions took place regarding sodium carbonate.



- (i) Calculate, by percentage of mass, the purity of sodium carbonate in **X**. [2]
- (ii) Hence, sketch a graph of pH of the solution against volume of HCl added. [4]

You should include all pH values of vital points where they are possible to calculate.

- (iii) State an essential assumption you made in your calculations. [1]





