
Titrants and acid-base standardization

A. Preparation and standardization of hydrochloric acid at a concentration of 0.1 mol/L

Please calculate the volume (mL) of HCl at a concentration of 38% and density of 1.18 g/mL you should use to prepare 0.5 L of HCl at a concentration of 0.1 mol/L.

1. Introduce about 100 mL of distilled water into a 0.5 L volumetric flask.
2. Transfer calculated volume of concentrated hydrochloric acid to the volumetric flask using a graduated cylinder.
3. Fill the volume of the flask with distilled water up to the mark using a wash bottle. Then, mix the solution.
4. Weigh approximately calculated mass of sodium carbonate in a weighing vessel with the required accuracy using the analytical balance. Dissolve sodium carbonate in 100 mL of distilled water.
5. Transfer 10 mL of the sodium carbonate solution to a conical flask.
6. Add 2-3 drops of **methyl orange**. The solution should be **yellow**.
7. Fill the burette with the prepared acid solution (HCl, 0.1 mol/L).
8. Titrate with the acid until a **light orange** colour appears. Repeat the titration to obtain three concordant results (not differing more than 0.2 mL).
9. Calculate the concentration of hydrochloric acid.

B. Preparation and standardization of sodium hydroxide at a concentration of 0.1 mol/L

Please calculate the volume (mL) of NaOH at a concentration of 0.5 g/mL you should use to prepare 0.5 L of NaOH at a concentration of 0.1 mol/L.

1. Introduce about 100 mL of distilled water into a 0.5 L volumetric flask.
2. Transfer calculated volume of concentrated sodium hydroxide to the volumetric flask using a graduated cylinder.
3. Fill the volume of the flask with distilled water up to the mark using a wash bottle. Then, mix the solution.
4. Fill the burette with the prepared sodium hydroxide.
5. Pipette 10 mL of hydrochloric acid solution of known concentration into the conical flask.
6. Add 2-3 drops of **phenolphthalein**. The solution should remain **colourless**.
7. Titrate the solution till a **slightly pink** colour appears. Repeat the titration to obtain three concordant results (not differing more than 0.2 mL).
8. Calculate the concentration of sodium hydroxide.

C. Simultaneous determination of hydrochloric and phosphoric acids

Dilute the analytical sample with distilled water in a measuring flask to the mark (100 mL) and mix completely. The solution in the measuring flask should be treated as 100 mL of the sample. **Pipette** 10 mL of the solution into the conical flask and dilute with distilled water to about 100 mL.

Add 2 drops of **methyl orange**. The solution should be **red**. Titrate with sodium hydroxide solution until the colour changes. Then, add 2 drops of **phenolphthalein** and 15 g of NaCl and titrate the sample with sodium hydroxide solution till a **slightly pink** colour appears. Repeat the titration to obtain three concordant results (not differing more than 0.2 mL). Calculate the amount of acids in 100 mL of the sample (mg).

Literature

- Analytical Chemistry (7th ed.); G.D. Christian, P.K. (Sandy) Dasgupta, K. A. Schug; John Wiley & Sons, Inc., 2014: Chapter 2: Basic Tools and Operations of Analytical Chemistry; Chapter 8: Acid-Base Titrations
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- Quantitative Chemical Analysis (7th ed.); D.C. Harris; W.H. Freeman and Company, NY, 2007: 2 Tools of the Trade (2-1÷2-9); 11 Acid-Base Titrations
- Lecture: Section 3; Section 6 and Section 7.