Volumetric Analysis

A student was given 14.0 g of a dibasic acid (H_2X). The dibasic acid was dissolved in water and made up to a 250.0 cm^3 solution. 25.0 cm^3 of the solution were titrated against 0.450 mol dm^{-3} sodium hydroxide solution with phenolphthalein as indicator. 32.0 cm^3 of the alkali were required to reach the end point.

(a) What is the meaning of the term 'dibasic acid'? Give an example of dibasic acid. [2]

(b) Write a chemical equation for the reaction between the dibasic acid solution and sodium hydroxide solution. [1]

(c) Briefly describe the procedure that should be followed to prepare a burette containing the sodium hydroxide solution for the titration. [3]

(d) State the colour change of the indicator at the end point. [1]

(e) Calculate the molar mass of the dibasic acid. [4]

(f) In the titration, the 0.450 mol dm^{-3} sodium hydroxide solution was used as a standard solution.

(i) What does the term 'standard solution' mean? [1]

(ii) Comment whether it is appropriate to prepare a standard solution of sodium hydroxide by the following procedure:

'Weigh a sample of solid sodium hydroxide, dissolve it in some distilled water and make up to a known volume of solution.' [1]

Suggested Answer

A student was given 14.0 g of a dibasic acid (H_2X). The dibasic acid was dissolved in water and made up to a 250.0 cm^3 solution. 25.0 cm^3 of the solution were titrated against 0.450 mol dm^{-3} sodium hydroxide solution with phenolphthalein as indicator. 32.0 cm^3 of the alkali were required to reach the end point.

(a) What is the meaning of the term 'dibasic acid'? Give an example of dibasic acid. [2]

An acid that can produce two hydrogen ions per molecule. 1

Example: sulphuric acid / sulphurous acid 1

(b) Write a chemical equation for the reaction between the dibasic acid solution and sodium hydroxide solution. [1]

$H_2X(aq) + 2NaOH(aq) \longrightarrow Na_2X(aq) + 2H_2O(l)$ 1

(c) Briefly describe the procedure that should be followed to prepare a burette containing the sodium hydroxide solution for the titration. [3]

Wash / Rinse the burette first with distilled / deionized water and then with the sodium hydroxide solution. 1

Clamp the burette vertically in a stand. Close the stopcock. Fill the burette with the alkali through a filter funnel. 1

Open the stopcock for a few seconds so as to fill the tip of the burette with alkali. 1

(d) State the colour change of the indicator at the end point. [1]

From colourless to pink. 1

(e) Calculate the molar mass of the dibasic acid. [4]

$H_2X(aq) + 2NaOH(aq) \longrightarrow Na_2X(aq) + 2H_2O(l)$

No. of moles of NaOH in 32.0 cm^3 solution
= 0.450 x 0.032
= 0.0144 1

No. of moles of H_2X in 25.0 cm^3 solution
= 0.0144 / 2
= 0.00720 1

No. of moles of H_2X in 250.0 cm^3 solution
= 0.00720 x 250 / 25
= 0.0720 **1**

Molar mass of H_2X
= 14.0 / 0.0720
= 194 g mol^{-1} **1**

(f) In the titration, the 0.450 mol dm^{-3} sodium hydroxide solution was used as a standard solution.

(i) What does the term 'standard solution' mean? [1]

A solution of known concentration. **1**

(ii) Comment whether it is appropriate to prepare a standard solution of sodium hydroxide by the following procedure:

'Weigh a sample of solid sodium hydroxide, dissolve it in some distilled water and make up to a known volume of solution.' [1]

Not appropriate as sodium hydroxide absorbs moisture in air readily. **1**