

EXPERIMENT

AIM

To determine volumetrically the number of water molecules of crystallization in oxalic acid $\left(\begin{array}{c} \text{COOH} \\ | \\ \text{COOH} \end{array} \cdot x\text{H}_2\text{O} \right)$ 6g of which has been dissolved to make 1L of solution. You are provided with $\frac{M}{10}$ NaOH solution.

MATERIAL REQUIRED

Sodium hydroxide solution $\frac{M}{10}$ hydrated oxalic acid solution, 6g of which has been dissolved to make 1 L solution, burette, pipette, conical flask, funnel.

PROCEDURE

Same as experiment 3.

The experiment involves the titration between oxalic acid and NaOH solution as explained in experiment number 3. From the concordant burette reading, the molarity of oxalic acid can be calculated which further enables us to calculate the molecular weight of hydrated oxalic acid if the strength is given. Now using the following formula, the number of waters of crystallization can be computed.

FORMULA

Mole mass of hydrated compound = molecular mass of anhydrous compound + 18 × number of H₂O of crystallization.

CALCULATION

The volume of oxalic acid in the titration flask = 10 ml.

The volume of NaOH solution used (concordant burette reading) = 9.9 ml (say)

$$n_{\text{oxalic acid}} \times M_{\text{oxalic acid}} \times V_{\text{oxalic acid}} = n_{\text{NaOH}} \times M_{\text{NaOH}} \times V_{\text{NaOH}}$$

$$2 \times M_{\text{oxalic acid}} \times 10 = 1 \times \frac{1}{10} \times 9.9$$

$$M_{\text{oxalic acid}} = \frac{9.9}{20} \text{ M}$$

$$\text{Strength}_{\text{oxalic acid}} = \text{Molarity}_{\text{oxalic acid}} \times \text{Mol. wt. of hydrated oxalic acid}$$

$$6 \text{ (given)} = \frac{9.9}{20} \times (90 + 18x) \text{ (Let } x \text{ be the water of crystallisation)}$$

$$x = \frac{6 \times 20}{9.9 \times 18 - 90}$$

i.e., the number of waters for the crystallization of oxalic acid is ____.

RESULT

Number of waters for the crystallization of oxalic acid is _____.

PRECAUTIONS

Same as experiment 3.

VIVA VOCE

Q 1. What is the purpose of determining the number of water molecules of crystallization in oxalic acid?

Ans. The purpose is to find the value of 'x' in the formula $\left(\begin{array}{c} \text{COOH} \\ | \\ \text{COOH} \end{array} \cdot x\text{H}_2\text{O} \right)$ by titrating it against a standard solution of $\frac{M}{10}$ NaOH.

Q 2. Explain the reaction between oxalic acid and M/10 NaOH.

Ans. The reaction involves the neutralization of oxalic acid ($\text{C}_2\text{H}_2\text{O}_4$) by sodium hydroxide (NaOH) to form water (H_2O), sodium oxalate ($\text{Na}_2\text{C}_2\text{O}_4$), and carbon dioxide (CO_2).

Q 3. Why is $\frac{m}{10}$ NaOH chosen as the titrant in this analysis?

Ans. $\frac{M}{10}$ NaOH is chosen because it reacts stoichiometrically with oxalic acid and allows for precise volumetric analysis.

Q 4. How can the number of water molecules of crystallization be calculated from the titration results?

Ans. The number of water molecules can be calculated using the formula: $x = \frac{\text{Volume of } \frac{m}{10} \text{ NaOH used} \times \text{Normality of } \frac{m}{10} \text{ NaOH} \times \text{Equivalent mass of oxalic acid}}{\text{Weight of oxalic acid sample}}$

Q 5. Explain the terms basicity of an acid and acidity of a base.

Ans. Number of replaceable hydroxyls (OH^-) ions furnished by a molecule of the base is known as its acidity and the number of replaceable hydrogens (H^+) ions furnished by a molecule of acid are called the basicity of an acid.

Q 6. What is meant by the term concordant readings?

Ans. The readings in volumetric analysis which differ by less than 0.05ml are called concordant readings.

Q 7. Can one take oxalic acid solution in the burette and sodium hydroxide solution in the titration flask? Point out the limitations of doing so, if any.

Ans. No, because if NaOH solution is taken in the conical or titration flask, the colour change at the endpoint would be pink to colourless. The accuracy in noting this change may be less as compared to the change from colourless to pink. Secondly, since NaOH is more corrosive out of the two, therefore, taking it in the burette eliminates the chances of it going into the mouth while pipetting.

Q 8. What color change phenolphthalein shows when it is used as an indicator in acid-base titration?

Ans. Phenolphthalein turns from colorless (in acidic medium) to pink (in basic medium).