

EXPERIMENT

Aim

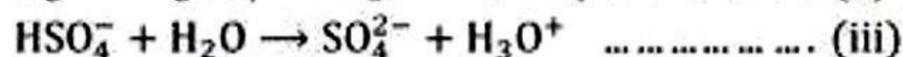
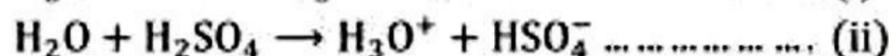
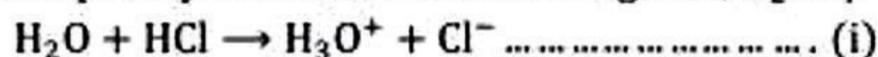
To compare the pH of the solution of strong and weak acids of the same concentration.

THEORY

pH is defined as negative logarithm of hydronium ion concentration.

$$\text{pH} = -\log [\text{H}_3\text{O}^+]$$

Strong acids are those which completely dissociate into ions. e.g. HCl, H₂SO₄



1 mole of HCl dissociates to form 1mol of H₃O⁺ [eq. (i)] whereas 1 mole of H₂SO₄ when dissociates completely [eq. (ii) and (iii)] gives 2 moles of H₃O⁺. Their pH can be calculated from their molar concentration. On the other hand, weak acids are those which do not dissociate into ions completely. [H₃O⁺] ion concentration in weak acids can be calculated knowing their degree of dissociation. Once H₃O⁺ ion concentration is calculated, pH also can be computed e.g.; acetic acid.



Initial conc. c 0 0

Final conc. c(1 - α) cα cα

$$\text{Degree of dissociation } K_a = \frac{[\text{CH}_3\text{COO}^-][\text{H}_3\text{O}^+]}{[\text{CH}_3\text{COOH}]} = \frac{c\alpha \cdot c\alpha}{c(1-\alpha)}$$

If α << 1, then 1 - α = 1

$$K_a = c\alpha^2$$

$$\text{and } [\text{H}_3\text{O}^+] = c\alpha$$

$$\text{pH} = -\log [\text{H}_3\text{O}^+] = -\log [c\alpha]$$

$$\text{or } \text{pH} = -\log c \sqrt{\frac{K_a}{c}}$$

$$\text{or } \text{pH} = -\log \sqrt{K_a \times c}$$

MATERIAL REQUIRED

Test tube, pipette, test tube stand, dropper, 0.1 M HCL and 0.1 M acetic acid

PROCEDURE

A strong acid is completely ionised in an aqueous solution. It produces a higher concentration of hydrogen ions for a given concentration of the acid as compared with a weak acid and hence has lower pH.

- (i) Take four clean and dry test tubes and half-fill each of the tubes with one of the acid solutions.
- (ii) Take 5 ml of 0.1 M HCl and 5 ml of 0.1 M CH₃COOH in the separate test tube.

- (iii) Put a drop of 0.1 M HCl on pH paper and note the colour as in experiment 1. Repeat with 0.1 M CH_3COOH solution also.

OBSERVATION

Sample	Concentration	Colour	pH
HCl	0.1M	-	-
CH_3COOH	0.1M	-	-

RESULT

pH of 0.1 M HCl solution (strong acid) is _____.

pH of 0.1 CH_3COOH (Weak acid) is _____.

PRECAUTIONS

- Add an equal number of drops of the universal indicator to equal amounts of solution in each of the boiling tubes.
- Match the colour of the solution with the pH chart carefully.

VIVA VOCE

Q 1. What is pH?

Ans. pH is a measure of the acidity or alkalinity of a solution. It stands for "potential of Hydrogen" and is defined as the negative logarithm of the hydrogen ion concentration in a solution.

Q 2. How is the pH scale defined?

Ans. The pH scale ranges from 0 to 14, where a pH of 7 is considered neutral. Solutions with a pH less than 7 are acidic, while solutions with a pH greater than 7 are basic or alkaline.

Q 3. What is a strong acid?

Ans. A strong acid is one that completely dissociates into ions when dissolved in water, leading to a high concentration of hydrogen ions (H^+) in solution. Examples include hydrochloric acid (HCl) and sulfuric acid (H_2SO_4).

Q 4. What is a weak acid?

Ans. A weak acid is one that only partially dissociates into ions when dissolved in water, resulting in a lower concentration of hydrogen ions (H^+) in solution. Examples include acetic acid (CH_3COOH) and carbonic acid (H_2CO_3).

Q 5. Explain the dissociation of a strong acid in water.

Ans. When a strong acid is dissolved in water, it dissociates completely into ions. For example, hydrochloric acid (HCl) dissociates into hydrogen ions (H^+) and chloride ions (Cl^-) in water according to the equation: $\text{HCl} \rightarrow \text{H}^+ + \text{Cl}^-$.

Q 6. How does concentration affect pH?

Ans. Generally, an increase in the concentration of hydrogen ions (H^+) leads to a decrease in pH, making the solution more acidic. Conversely, a decrease in hydrogen ion concentration results in a higher pH, making the solution more basic.