EXPERIMENT

AIM

To study the pH change in titration of a strong base with a strong acid using a universal indicator.

THEORY

Titration of strong acid and strong base involves neutralisation reaction.

$$NaOH + HCl \longrightarrow NaCl + H_2O.$$

During titration pH of the solution taken in the conical flask changes as the other solution is added from the burette. If NaOH is added from the burette and HCl is taken in the conical flask, during the titration pH of the solution in the conical flask will increase.

MATERIAL REQUIRED

burette, pipette(10ml), Conical flask, dropper, white tile, funnel, universal indicator, 0.1 M NaOH, 0.1 M HCl, 1 M NaOH, 1 M HCl, 0.5 M NaOH, 0.5 M HCl

PROCEDURE

(i) Fill up the burette with 1 M NaOH solution. Note down the initial burette reading.
(ii) Pipette out 10ml of 1 M HCl solution. Note down the initial burette reading.
(iii) Add a few drops of universal indicator.
(iv) Note down the colour of the solution in the conical flask and note down the pH.
(v) Run down NaOH from the burette slowly and note the change in the colour of the solution.
(vi) Record the volume of NaOH used for every colour change.
(vii) Record your observations.
(viii) At the end point when the amount of HCl has been completely neutralized by NaOH, the extra drop of strong alkali will give purple colouration due to high pH. Range 12-14.

OBSERVATION

Solution in conical flask = 10 ml of 1 M HCl.

OBSERVATION TABLE

S. NO.	Volume of NaOH	Color of the Solution	pH range

RESULT

There is a gradual change in the colour in the beginning as the pH is varying gradually due to the addition of NaOH dropwise. This NaOH is being used by HCl gradually. At the endpoint, there is a sudden change in colour to purple (the solution will be alkaline). The final colour will be different in end points using (0.1 M NaOH, 0.1 M HCl) and (0.5 M NaOH, 0.5 M HCl).

PRECAUTIONS

(i) Use a small amount and an equal number of drops of indicators every time.
(ii) Keep the conical flask over the white paper so that the colour change is easily available.

VIVA VOCE

Q 1. What is the purpose of using a universal indicator in the titration of a strong base with a strong acid?

Ans. The universal indicator is used to visually observe and determine the pH changes that occur during the titration process. It provides a range of colors across the pH scale, allowing us to identify the endpoint of the titration.

Q 2. How does the color change of the universal indicator correspond to changes in pH?

Ans. The color change of the universal indicator corresponds to the pH of the solution. Different colors are associated with different pH values, enabling us to track the pH changes during titration.

Q 3. Why is it important to titrate a strong base with a strong acid rather than a weak acid?

Ans. Titrating a strong base with a strong acid ensures a complete and rapid reaction, resulting in a sharp and easily identifiable endpoint. This allows for accurate determination of the equivalence point and precise measurement of the volume of titrant required.

Q 4. What is the significance of the equivalence point in titration?

Ans. The equivalence point is the point at which the moles of acid added are stoichiometrically equivalent to the moles of base present in the solution. At this point, the reaction is complete, and the pH of the solution is neutral.

Q 5. Describe the pH change during the titration of a strong base with a strong acid.

Ans. Initially, the pH of the solution is high due to the presence of excess hydroxide ions from the strong base. As the strong acid is gradually added, the pH decreases until it reaches the equivalence point, where it becomes neutral.

Q 6. How can the endpoint of the titration be determined accurately?

Ans. The endpoint of the titration can be determined by monitoring the color change of the solution using the universal indicator. The endpoint is reached when the indicator changes color, indicating that the reaction is complete.

Q 7. What factors could affect the accuracy of the titration results?

Ans. Factors such as impurities in the chemicals, improper calibration of equipment, incomplete mixing of solutions, and inaccurate observation of the endpoint could affect the accuracy of the titration results.

Q 8. Explain the role of a burette in titration.

Ans. A burette is used to accurately measure and dispense the titrant (the solution of known concentration) into the solution being analysed. It allows for precise control of the volume of titrant added, ensuring accurate results.

Q 9. How can the concentration of the strong base be determined from the titration data?

Ans. The concentration of the strong base can be determined from the volume of the strong acid required to reach the equivalence point, using the stoichiometry of the reaction and the known concentration of the acid.

Q 10. What safety precautions should be taken during titration experiments?

Ans. Safety precautions include wearing protective equipment such as goggles and gloves, handling chemicals with care, working in a well-ventilated area, and following proper laboratory procedures to minimize the risk of accidents or exposure to hazardous materials.