Abdelhafid Boussouf University Center - Mila **Academic year 2024-2025**

Institute of Natural and Life Sciences

Biological and Agricultural Sciences/ Biotechnology/ Ecology and Environmental Sciences

Practical Work N° 3:

pH-metric Titrations

1. The Purpose of the Practical Work

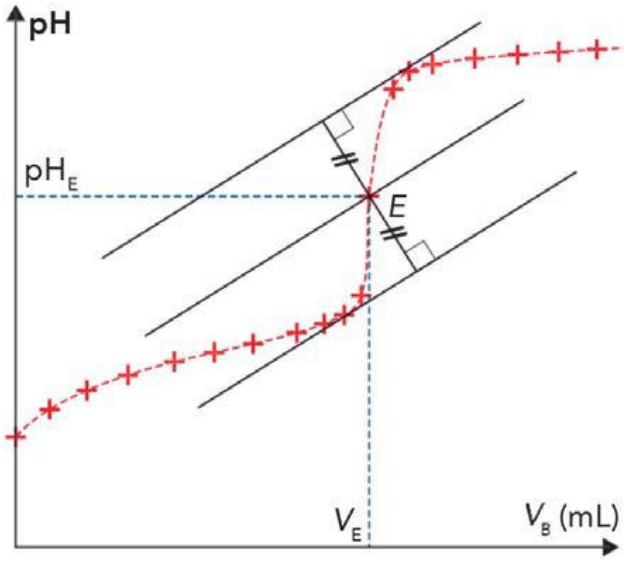
- Determination of the concentration and the value of the acidity constant of acetic acid by the pH-metric method.

2. Principle

The titration of an acid (or basic) solution consists in determining the concentration of acid (or base) added to this solution. To do this, a precise volume of the solution of an unknown concentration of acid (or base) is titrated by a base (or acid) solution of known concentration is titrated in order to determine the equivalence. During a pH-metric titration, the pH of the titrated solution is measured for each volume of titrant solution poured. In order to be able to represent regularly distributed experimental points, the titrant solution must be added milliliter by milliliter before and after the equivalence but "tighten" the pours in the vicinity of the equivalence. The pH-metric titration curves (pH = f (V_{added}) giving the variations in pH as a function of the volume of titrant solution poured in show sudden pH jumps at the equivalence. To identify the equivalent volumes, we can use:

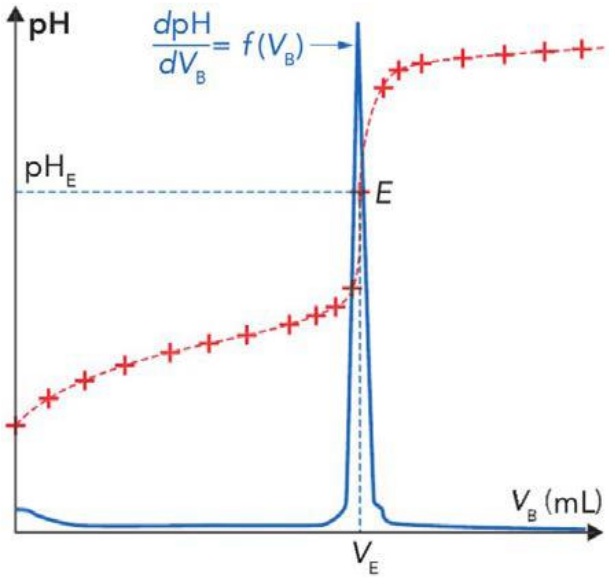
- **The tangent method**

It consists of drawing two tangents to the curve pH = *f* ($V_{Sol.titrant\ poured}$), parallel and placed on either side of the inflection point; then drawing a straight line parallel to these two tangents, equidistant from them. This last straight line intersects the titration curve at the equivalence point E, with abscissa V_E and ordinate pH_E



- **The derivative curve method**

It is sufficient to represent, on the titration curve, the curve $\frac{dpH}{dV} = f(V_{Sol.\ titrant\ poured})$. The abscissa of the extremum of this curve corresponds to the volume V_E of titrant solution poured at the equivalence.



3. Experimental part

3.1. Materials and products

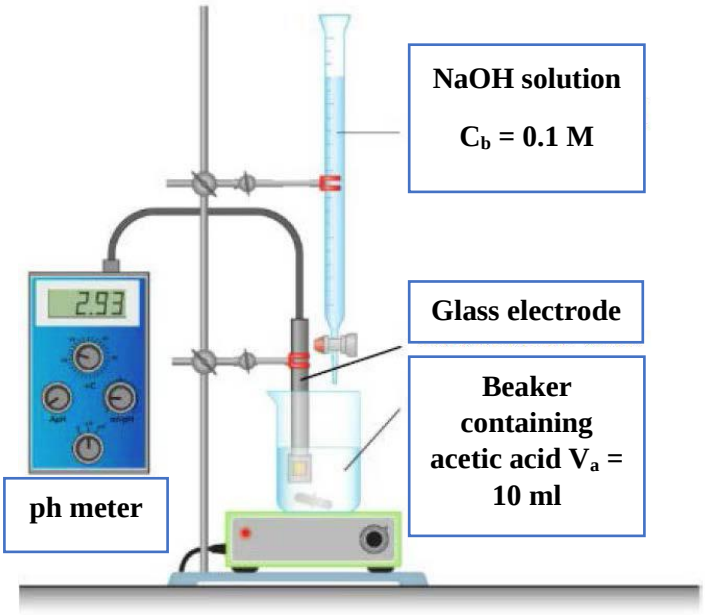
- Graduated burette, 100 mL beaker, pH meter, Magnetic stirrer

- Sodium hydroxide solution **NaOH (0.1 mol/L)**, Acetic acid solution **CH_3COOH**

3.2. Operating mode

Procedure Before performing the titration, dilute the commercial vinegar to 1/10

- Introduce, in a burette, the aqueous solution of sodium hydroxide (NaOH) of known molar concentration C_b = 0.1 mol/l
- Take 10 ml of the diluted acetic acid solution, pour them into a 150 ml beaker and add approximately 25 ml of distilled water
- Place the beaker under the burette. Immerse the pH-metric probe in it
- Set up the magnetic stirrer and the magnetic bar
- Titrate these 10 ml of the diluted solution by pouring, milliliter by milliliter, the titrating reagent (NaOH of concentration C_b = 0.1M) into the beaker
- At each addition, record in a table the volume of titrating solution poured and the pH of the solution.



- **The experimental results are collected in the following table:**

The volume of NaOH poured	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**
pH of the solution																

4. Required Questions:

1) Plot the pH = f (v) curve and determine $V_{b,eq}$ of the sodium hydroxide solution poured at the equivalence
2) What features of the curve indicate that we are dealing with a weak acid?
3) Determine the pKa value of the acid used using the curve.
4) Determine the initial concentration of the dilute ethanoic acid solution. Find the pH value at the equivalence point by calculation. The necessary formulas will be demonstrated.
5) What is the molar concentration of ethanoic acid in commercial vinegar?
6) What is the degree of acidity of the vinegar? (mass in grams of pure ethanoic acid contained in 100 g of vinegar).
7) Conclusion