

Practical work n°2**pH-metric titration****1- Introduction**

The pH meter is an analytical instrument used to measure the acidity or basicity of an aqueous solution by determining its pH value. It operates by means of a glass electrode that responds selectively to hydrogen ions in solution, allowing accurate and continuous pH measurements. Because pH variations reflect changes in acid–base equilibria, the pH meter is an essential tool in acid–base titrations.

2-Objective of the practical work

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

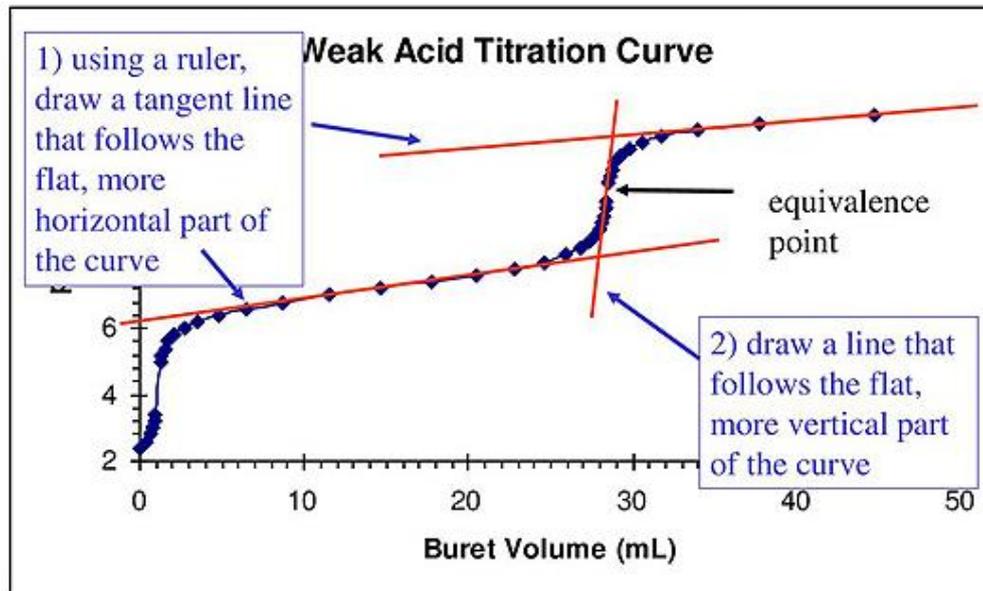
3-Principale

The titration of an acidic (or basic) solution consists in determining the concentration of the acid (or base) present in the solution. To do this, a precise volume of the solution with unknown concentration is titrated with a base (or acid) solution of known concentration in order to determine the equivalence point.

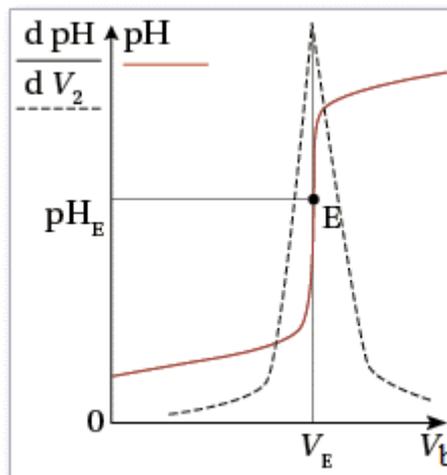
During a pH-metric titration, the pH of the titrated solution is measured for each volume of titrant added. In order to obtain regularly distributed experimental points, the titrant solution must be added milliliter by milliliter before and after the equivalence point, with smaller additions made in the vicinity of the equivalence point.

pH-metric titration curves ($\text{pH} = f(V_{\text{added}})$), which show the variation of pH as a function of the volume of titrant added, exhibit sharp pH jumps at the equivalence point. To identify the equivalence volumes, we can use:

- **The tangent method:** It consists of drawing two parallel tangents to the curve $\text{pH} = f(V_{\text{titrant added}})$, placed on either side of the inflection point. Then, a straight line parallel to these two tangents and equidistant from them is drawn. This final line intersects the titration curve at the equivalence point E, whose coordinates are the equivalence volume V_E and the corresponding pH value pH_E .



- **The derivative curve method:** It consists of plotting, from the titration data, the curve $\frac{dpH}{dV} = f(V_{\text{Sol. titrant poured}})$. The x-coordinate of the extremum of this curve corresponds to the equivalence volume V_E of the titrant added.



4- Materials and chemicals

- Graduated burette
- 100 mL beaker
- pH meter
- Magnetic stirrer
- Magnetic stir bar
- Sodium hydroxide solution NaOH (0.1 mol/L)
- Acetic acid solution CH₃COOH

5- Experimental procedure

Before carrying out the titration, prepare a 1/10 dilution of the commercial vinegar.

-Fill a burette with an aqueous sodium hydroxide (NaOH) solution of known molar concentration $C_b=0.10 \text{ mol/L}$.

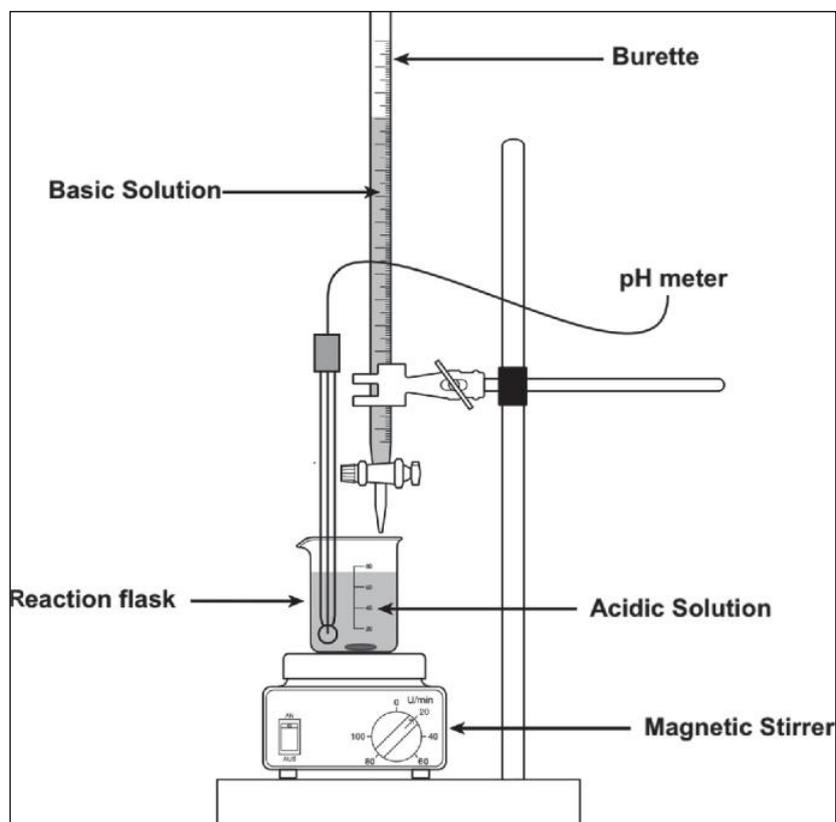
-Using a pipette, take 10 mL of the diluted acetic acid solution and pour it into a 150 mL beaker. Add approximately 25 mL of distilled water.

-Place the beaker under the burette and immerse the pH electrode in it.

-Set up the magnetic stirrer and place a magnetic stir bar in the beaker.

-Perform the titration by adding the titrant (NaOH solution, $C_b=0.10 \text{ M}$) milliliter by milliliter from the burette into the beaker.

-After each addition, record in a table the volume of titrant added, and the pH of the solution.



Volume of NaOH added	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
pH of the solution																

-Complete the table above.

-Plot the $\text{pH} = f(v)$ curve and determine $V_{b,eq}$ of the sodium hydroxide solution poured at the equivalence.

-What features of the curve indicate that we are dealing with a weak acid?

- Determine the pKa value of the acid used using the curve.
- What is the molar concentration of ethanoic acid in commercial vinegar?