Experiment (6)

Potentiometric titration of strong acid with strong base

Introduction:

Potentiometric titration is a laboratory method to determine the concentration of a given analyte (unknown). In this method, there is no use of a chemical indicator. Instead, the pH or electric potential across the substance is measured. By using the measurements of pH in this process can determine the equivalent point.

pH express to measure the hydrogen ions in solutions, or it's the negative logarithm for the activity of hydrogen ions in solution (pH = -log a_{H^+}*)*

Potentiometric titration is provide more reliable data than data from titrations that use chemical indicators and are particularly useful with colored or turbid solutions and for detecting the presence of unsuspected species

Difference between Equivalence point and Endpoint

Equivalence point	Endpoint
The point in the titration process where the chemical reaction in the titration mixture ends is called equivalence point.	The point in the titration process which is indicated by color change of the indicator is called endpoint.
It is the point where the analyte has completely reacted with the titrant.	It doesn't always give the point where the analyte has completely reacted with the titrant.
It is not always indicated by color change of the reaction mixture.	It is always indicated by the color change of the reaction mixture.
It gives the point where reaction ends.	It doesn't always give the point where reaction ends.
It comes either almost with endpoint or before the endpoint.	It comes either almost with the equivalence point or after the equivalence point.
Weak acids can show multiple equivalence points during titration.	Weak acids can show only one endpoint during titration.

Potentiometric titrations classified as precipitation titrations, complex formation titrations, oxidation/reduction titrations and acid-base titrations (neutralization titrations).

Procedure:

A- Titration by using indicators:

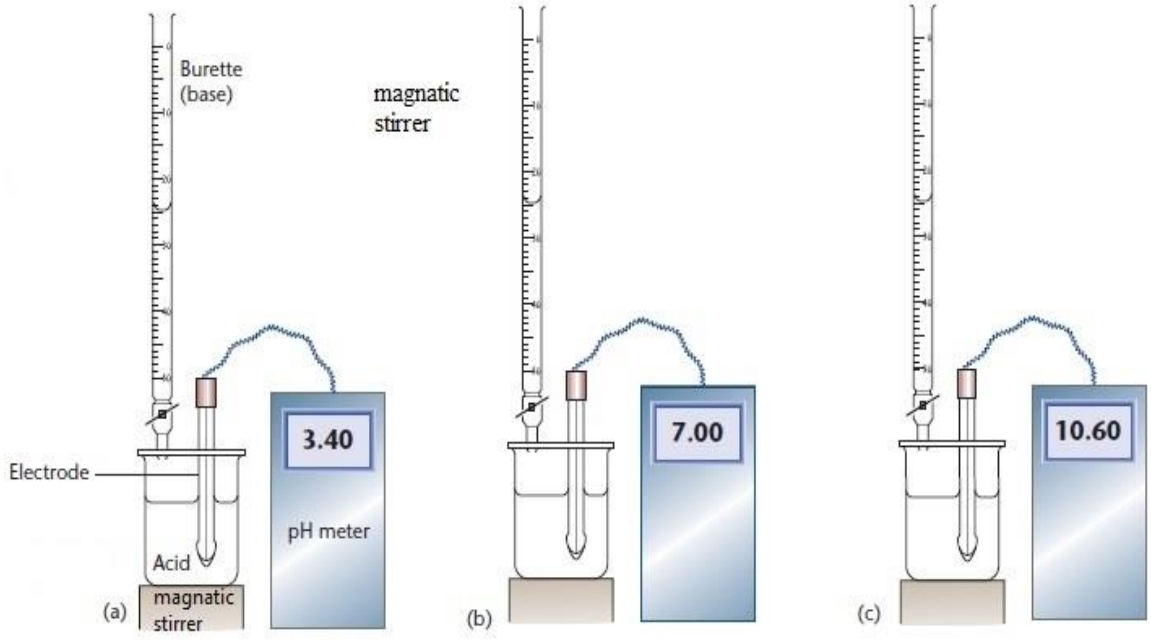
Take (25mL) of HCl (unknown) and put it in the beaker with capacity (100mL) then add two drops of indicator (phenolphthalein). Start titration with the solution (0.1M) of NaOH until the color of the solution changed to pink, finally determine the volume of base which represents the volume at end point. Calculate the molarity of HCl solution.

$$M_{acid} \times V_{acid} = M_{base} \times V_{base}$$

B- Titration by using pH –meter:

1- Wash the electrode with D. W. and dry it by filter paper then immerse it many times in beakers that contain the buffer solutions: pH =4, pH =9.

2- wash the electrode again and dry it by filter paper then immerse it the beaker with capacity (250mL) which contain (25mL) of HCl (unknown) and record the pH value.



3-begin the titration by adding the base of NaOH (0.1M) that is in burette, according to the following steps:

a-At first, add (1mL) at time, towards the equivalence point, then reduce the amounts (about 0.1 mL) at the end.

b- Continue the titration, now adding larger volumes of NaOH until the pH stop to rise markedly.

Increments, mL	Volume of NaOH, mL
1	0-8
0.1	8-12
1	12-18
0.1	18-22
1	22-28

4- Record the values of pH for the mixture in the beaker after each addition.

5- In the end of experiment, wash the electrode and immerse it in the D. W.

Calculations:

1- Set table including the results of above method like below table.

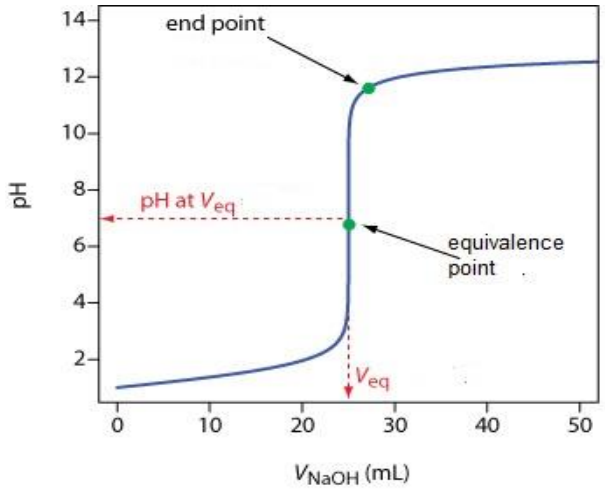
2- Plot a graph between the values of pH and volumes of NaOH like shape (A)

3- Determine the equivalence point and *calculate the molarity of HCl solution.*

$$M_{acid} \times V_{acid} = M_{base} \times V_{base}$$

V_{NaOH} (mL)	pH
0	
1	
2	

.....-	
28	



Discussion:

1- Why is HCl consider a strong acid?

2- Classify the electrolytes in terms of equivalence?