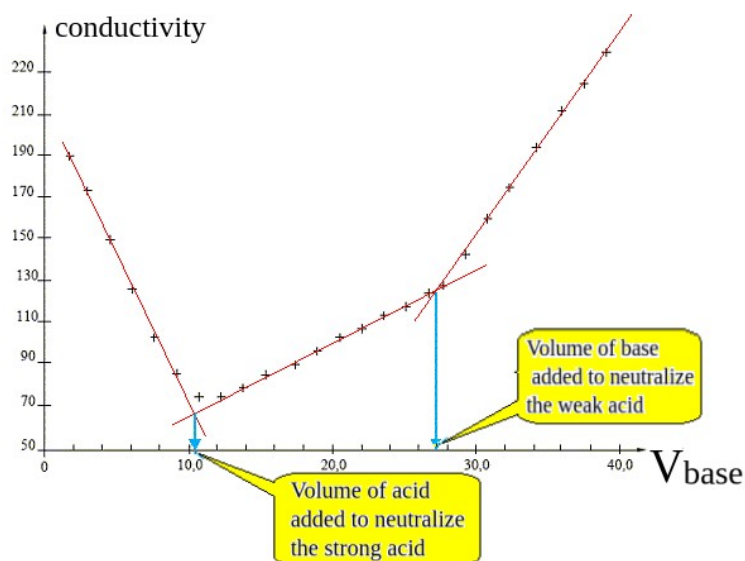


CB102 : Experiment 5 : Determination of amount of acetic acid present in a solution using conductometric titration:

I- INTRODUCTION

The conductivity of an electrolytic solution depends on the number of ions present in solution, their charge and mobility. When one electrolytic solution is added to another, ionic interactions occur, resulting in changes in the conductivity of the solution. This is the basis of conductometric titration method. In certain situations, this method of titration is advantageous over traditional indicator-based titration method, since more than one type of acid or base can be simultaneously titrated accurately. For example, the addition of a strong base (NaOH) to a mixture of strong acid (HCl) and a weak acid (CH_3COOH) causes changes in the conductivity of the solution, as depicted in the following figure.



Upon adding of a strong base to the mixture of strong and weak acids, the conductivity initially falls due to the neutralisation of the strong acid and then increases marginally as weak acid is converted into its salt and finally increases more steeply as excess alkali is introduced. Using the intersecting points of the straight line regressions of these three regions of the plots, two end points can be simultaneously determined.

Objective: To determine amount of CH_3COOH present by titrating against a strong base (NaOH), conductometrically.

II- PRELIMINARY WORK

Read carefully the procedure, and make the necessarily preliminary calculations for all the standard solutions.

III- PROCEDURE

Chemicals required for cell calibration:

- 0.1M Potassium chloride KCl

Chemicals required for titration:

- 2.5M NaOH standard solution
- 2M HCl standard solution
- acetic acid of unknown concentration



Apparatus and laboratory glassware required : See appended.

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Calibration of the conductivity cell: To measure accurate values of conductivity of the solution, the instrument needs to be calibrated first. To do this a standard solution of potassium chloride is required. Using the 0.1 M KCl solution provided to you, prepare 50 ml of 0.01 M KCl solution. Caution: Use de-ionized water for dilution. Using this as standard, determine the cell constant of your conductivity cell as detailed below:

- 1) Switch on the conductivity meter.
- 2) Make sure that the nob on the right hand top is set at check. The reading should read close to 1.000, if not adjust the nob at the back of the instrument to set the display close to 1.000.
- 3) Carefully replace a beaker containing 0.01M KCl solution beneath the conductivity cell. Note: Anytime during the experiment the electrode cell should not be left dry, if no measurement is being made leave the cell in a beaker with distilled water.
- 4) Turn the nob from check to conductivity to read the conductivity value. The standard conductivity of 0.01M KCl at 30° C is 1.547 mS/cm (S=Siemens = 1/resistivity).
- 5) If the value displayed is different from the above value, gently turn the calibrate nob on the left corner on the front of the instrument to achieve a value as close as possible to the expected value. Note: the conductivity value depends sensitively on the temperature. Therefore refer to the standard table provided and the room temperature to know the expected value.

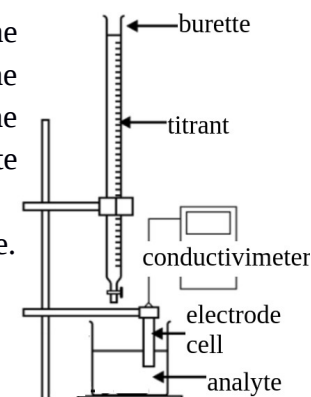
- 6) Once calibrated using the above procedure the calibrate nob should not be touched till the entire measurement is finished.
- 7) Once calibration is completed note down the cell constant value by putting the instrument in the cell constant mode (by turning the nob on the right side).

Preparation of solution :

- Prepare a 50.0 ml of 1M NaOH standard solution by diluting the 2.5M NaOH standard solution provided.
- Prepare 50.0 ml 0.2M HCl standard solution by diluting the 2M HCl standard solution provided.

Titration procedure:

- 1) Fill a burette with the prepared 1M NaOH.
- 2) Take 20.0 ml of the 0.2M HCl solution in a 100 mL beaker. Add 10.0 ml of the unknown solution of acetic acid supplied to the beaker. Mix them well.
- 3) Introduce the solution in the conductivity cell and measure the conductivity by turning the nob (on the right top) to conductivity mode. Note down the value of the conductivity.
- 4) Arrange the set up as in figure opposite.



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- 5) Add 0.5 ml of NaOH solution to the beaker containing mixed acid solutions. Mix the contents well and measure the conductivity again.
- 6) Repeat this process for every 0.5 ml addition of NaOH and record the conductivity values (in mS/cm)
- 7) A trend as depicted in the figure should be apparent after the second end point is reached. Stop the titration at least 6 measurement after passing the second end point.
- 8) Make a plot of the conductivity vs volume of NaOH added.
- 9) Draw the best fit lines through your data points.
- 10) Using this plot determine the two end points. Using the first endpoint calculate the concentration of NaOH standard. Using the second end point calculate the concentration of the unknown acetic acid solution ($V_1M_1=V_2M_2$)

Conclusions: Explain qualitatively the trend observed in the conductivity in terms of the ions present in solution.

Conductivity of the different ions :

ion	H_3O^+	HO^-	Cl^-	Na^+	CH_3COO^-
$\lambda(mS.m^2.mol^{-1})$	35.0	19.9	1.01	7.63	4.09

Questions: Why is NaOH not a primary standard? What does represent the cell constant?

APPENDED :

apparatus and glassware required

- Pipet pump
- conductivity meter
- Wash bottle
- 500 mL beaker for waste
- 100 ml beaker for titration
- 50mL flask
- two 250mL beakers
- funnel
- 10mL volumetric pipette
- 5mL volumetric pipette
- dropper
- burette on stand