University Center A. Elhafidh Boussouf Mila

Institute of Science and Technology

Department of Mechanical and Electromechanical Engineering Process Engineering 2nd year

**Solution Chemistry practical’s Works**



**Dr : Merzouki S.**

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**Experiment 2 : Conductivity measurement**

We will observe the electrical conductivity of several solutions and during dosage reaction using a conductivity-meter

# Introduction

The electrical conductivity of a solution accounts for its ability to conduct an electric current. In chemistry it is often noted σ, and in electromagnetism γ. It is related to the electrical resistance of a portion of solution. The resistance R of a portion of length L and cross-section S is given by:

$R=\frac{1}{σ}\frac{L}{S}$**(Unit: the ohm, Ω).**

We also define conductance, which is the inverse of resistance:

***C* =** $\frac{I}{U}=\frac{1}{R}$**= σ**$\frac{S}{L}$ **(unit: Ω −1, also called Siemens, noted S).**

This last relation makes it possible to obtain the unit of conductivity:

**Ω−1 = [σ] × m2/m, hence [σ] = Ω−1 ·m−1 = S · m−1.**

It is obviously the ions that ensure this electrical conduction by moving in the solution. The conductivity is therefore proportional to their concentrations. The constant of proportionality is denoted λo and accounts for the fact that each species of ion moves more or less easily in the solution (see Kohlraush's law below).The conductivity of an ionic solution is given by Kohlraush's law:

**σ =** $\sum\_{i}^{}λ\_{o\_{i}}c\_{i} $**(c:** normalité) .

 • The coefficient λoi is measured experimentally and is available in tables. It is called molar conductivity (It is always positive, regardless of the sign of the charge carried by the ion)

# reagents: Solutions of: NaOH (0,1N), HCl(0,1N), CH3COOH (0,1N), Venagre.

# **Calibration of the conductivity-meter**

A conductivity-meter is used, which imposes an alternating voltage **V** between two plates that dip in the solution. The device then measures the resulting current i. He deduces the conductance ***C*** of the solution between the two plates. The conductance is proportional to the conductivity: **σ = *C/*k**, with **k** a constant of proportionality which is **k = L/S**. Therefore, if you want to measure the **σ** conductivity of the solution, you must first calibrate the conductivity-meter by dipping it in a solution whose conductivity is already known.

# Procedure:

1. Make sure to have DI water enough in small beaker so tip of electrode is immersed in
2. Plug in the power supply and turn on.
3. Connect the conductivity electrode to the conductivity-meter.
4. Immerse conductivity electrode into beaker of solution of calibration.
5. Click on Sensors on the top of the screen and click Calibrate.
6. You are now ready to measure the conductivity.

**Part 1**

1. Measure the conductivity of the distilled water used.
2. Prepare a series of solutions of concentrations 10-1N, 10-2N, 10-3N and 10-4N of each solution.
3. Place 50 ml of each solution.
4. Insert the measuring electrode into the beaker.
5. Measure the conductivity of each solution starting with the dilute.
6. Rinse the cell before measurement with 2 or 3 times with DI water.
7. Draw the curve σ=f(c).

**Part 2**

1. Place the soda solution in the burette.
2. Place 50 ml of the vinegar (diluted 10 times) in the beaker.
3. Add one drop of the colour indicator (phenolphthalein)
4. Place the beaker on a magnetic stirrer and add the magnetic bar.
5. Insert the measuring electrode into the beaker.
6. Gradually pour the NaOH solution into the beaker.
7. Measure conductivity for each value of VB.
8. Draw the curve σ=f(VB).

# QUESTIONS :

* Give the molar conductivity of each solution.
* Determine the equivalency point.
* What is the value of conductivity at the equivalence point? and what does it represent?
* Calculate the degree of vinegar used.