جامعة الموصل/ كلية التربية للعلوم الصرفة
قسم الكيمياء

الكيمياء الكهربائية

المرحلة الثالثة

Electrochemistry

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المحاضرة الاولى

Electrochemistry

is the study of the chemical effects resulting from the passage of an

electric current, and it is a bridge between thermodynamics and the

remaining chemistry

Applications of electrochemistry

1- Enable us to study ionic interactions (salvation of electrode (surfaces

2- Purification and corrosion of metals.

3- Study of fuel cells

4- Study the cells that generate electricity directly from the fuel

5- It helps in determining the (pH) values and knowing the chemical behavior of the elements

Conductive material

It is a material that allows electricity to pass through it

for example

1-silver 2- copper 3- gold 4- Platinum

5- iron 6- Aluminum7- Mercury8- Carbon.

and other metals.

Insulating material

It is a material that does not allow electricity to pass through it.

for example

1-Plastic2- wood3- wool4- paper5- glass.6- For filament7- nylon, rubber.

Electrical conductivity can be divided:

1- Conduction in the case of gas.

2-. Conduction in the case of solids

3- Conduction in the liquid state (solutions).

Given the importance of conduction in the liquid state, we will focus on

studying this type, and for this we need several laws in the study of this type of electrical conduction

Electricity

it is a torrent of electrons, and that is why this stream of electrons must

flow through conductive materials, which in turn are divided into two

types.

1- Metals (metallic conductors).

2- Electronic materials: (ionic solutions).

المحاضرة الثانية

Viscosity:

is the resistance of a liquid to flow (a measure of the velocity of flow of a liquid under the influence of certain forces).

The viscosity arises from the forces of friction between the layers of the liquid during its movement to each other (caused by the presence of attractive forces (cohesion) between the molecules of the liquid that cause internal friction), and this effect is weak in solutions of low viscosity such as ethyl alcohol and water with an easy flow (fast). As for other solutions, such as motor oils or polymers of high viscosity, their flow is slow to a large extent.

Units used to measure viscosity:

1-Pascal. seconds (Pa.s), which is equivalent to the unit (kg / m.s).

2- Dyne. Sec / cm2 It's called Poise.

Viscometers:

Viscometer

These devices are also known as a capillary viscometer, also known

as a viscometer (Ostwald)

Diffusion: It is the movement of fluid from a region of higher

concentration to a region of lower concentration

Examples of diffusion

*Table salt in the water is spread until it is evenly distributed

throughout the liquid.

*The Perfume spreads throughout the entire room.

And other examples

Diffusion laws:

Fik,s First Law

The flow of a given substance through a certain surface perpendicularly is directly proportional to the increase in concentration

$J=-D\ dc/dx$

The first law

J=g/cm2.sec

D=-J/(dc/dx) (g/cm-2sec)/g.cm-4

D=cm2.sec-1

Fik,s second Law

This law is considered the basis for the first law while preserving the mass of material to reduce the flow process

$\boldsymbol{d\ C}$ / dt = D dc/dx

Equivalent Conductance:

Delivery of a(1 cm3) electrolyte solution containing 1 gram equivalent of electrolyte in 1 liter (i.e., 1 standard solution).

$\Lambda eq = 1000k / N$

Molar Conductance

Delivery of a (1 cm3) electrolyte solution containing one mole of electrolytes in one liter (i.e. one molar solution).

$\Lambda m = 1000k$ /M

المحاضرة الثالثة

Kohlraush law of independent migration of ions

Kohlraush's law of independent migration of ions

This law states that:

The conductivity or equivalent conductivity of any electrolyte in infinite

dilution Equals the algebraic sum of the equivalent infinite conduction or

conduction of the resulting ions That electrolyte disintegrated.

$\Lambda 0 = \lambda\ 0 + + \lambda\ 0-$

= quivalent conduction at infinity dilution$\boldsymbol{\Lambda\ 0}$

$\boldsymbol{\lambda\ +0}$ = Positive ion conduction symbol at infinite dilution.

$\boldsymbol{\lambda\ -0}$ =Negative ionic conduction symbol at infinite dilution.

According to Kohlraush law, we write the infinite conduction of the electrolyte with the formulas,

$\Lambda 0 = v \quad + \lambda + + v \quad -\lambda-$

The Onsaker equation

This equation is applied to calculate the conductivity of mono salts, very dilute salts and weak acids, and the Onsaker equation can be written as follows:

$\boldsymbol{\Lambda} \quad = \boldsymbol{\Lambda}\ \mathbf{0} \quad - A\ \sqrt{c}$

Activity and Activity Coefficient:

Activity :It is the effective focus, which equals a fraction of the focus the user

Activity Coefficient: It is a measure of the solution's deviation from the

ideal state.

Debye-Huckel theory

A theory explaining the imperfect behavior of electrolytes. This theory was published in 1923 by Peter Depay and Eric Huckel (1896-1980). This theory assumes (that electrolytes completely dissociate in solution and that their abnormal behavior appears due to electrostatic interactions between ions). This theory also explains how to calculate the excess free energy for each ion resulting from those reactions, and thus the activity factor. This theory also provides a great description of the behavior of electrolytes that are not ideal for very dilute solutions but cannot be applied to concentrated electrolytes.

المحاضرة الرابعة

Chemical cells

It is classified into two types:

1- Galvanic cells :It is the process of converting chemical energy into electrical energy,

and it can be called voltaic cells

2- Electrolyte cells : They are cells that convert electrical energy into chemical energy as

(opposed to voltage cells).

Measurement of electromotive force(E.M.F)

(It is an expression of the difference in the electric voltage of the unit of charge, and it can be measured in the unit of volt.) So when the electric current passes, it means the passage of negatively charged electrons in the outer circuit from the anode to the cathode, where the positive cations are heading towards the cathode and the negative anions are directed towards the anode and when the cell is connected to the galvanometer, we will notice The deflection of the galvanometer needle indicates the passage of electric current I from one electrode to the other ,

Reversible cells

It is a type of electrochemical (electrolyte) cell.

But it must meet the following conditions

1-That the cell's electromotive force is equal to the external voltage acting

from an external source.

2 - That the external voltage is sometimes slightly greater than the electric

motive force of the cell.

The Nernst Equation

This equation is named after the German chemist Walter Hermann

Nernst.

This equation relates the cell voltage to the cell concentration which

forms the final galvanic electrical reaction.

This equation applies to electrical cells in nonstandard conditions.

Reference electrodes

It is a group of electrodes in which the voltage is known.

It can be divided into several types:

1- Standard hydrogen electrode

2- The calomel standard electrode

3-Silver electrode - silver chloride

4-Glass electrode

المحاضرة الخامسة

Thermodynamic for electrical cells

This topic is considered an important topic as it is considered (ΔG) represents free energy, and when we connect this value to the lectromotive force we get the following law:

$\Delta G = -n F E$-----(1)

n=This topic is considered an important topic as it is considered

F=Faraday number(96500 coloum)

E=Cell voltage

And to calculate the value of(Δ S) through the previous laws in throdynamic

$\Delta S = nF\,(\partial E/\partial T)P$-----(2)

As for the value of H, it is calculated according to the following law:

$\Delta H = \Delta G + T\Delta S$ $\Delta H = -\,nFE + nF\,T(\partial E/\partial T)P$ ---(3)

$\Delta H = nF\,[E - T(\partial E/\partial T)P]$-----(4)

Example1

In the next cell

Cd|Cd Cl2.1/2H2O|| Satsolution AgCl|Ag

The(EMF) was(0.67533 volt) at (25 C 0)and the(əE/əT)P was (6.5 x 10-4)

volt. Calculate (ΔG, ΔS, ΔH) for this cell at this temperature.