ELECTRO-CHEMISTRY

Electrolytes

Electrolytes are substances that break apart into ions (charged particles) when dissolved in water or another solvent or in molten stage.

When certain compounds like salts, acids, or bases dissolve in water, they dissociate into positively and negatively charged ions. These ions can move freely in the solution and carry electrical current. For example, table salt (sodium chloride) dissolves in water to form sodium ions (Na^+) and chloride ions (Cl^-), both of which can conduct electricity.

Electrolytes are categorized into **two** main types based on their behavior in solution:

Strong Electrolytes: These substances completely dissociate into ions when dissolved in water. Examples include soluble salts like sodium chloride (NaCl) and strong acids like hydrochloric acid (HCl).

Weak Electrolytes: These substances partially dissociate into ions when dissolved in water. Examples include weak acids like acetic acid (CH_3COOH) and weak bases like ammonia (NH_3).

Mechanism of Electrolytic Conduction

The mechanism of electrolytic conduction involves the movement of ions through a solution or a molten electrolyte under the influence of an electric field. This movement of ions is what allows the electrolyte to conduct electricity.

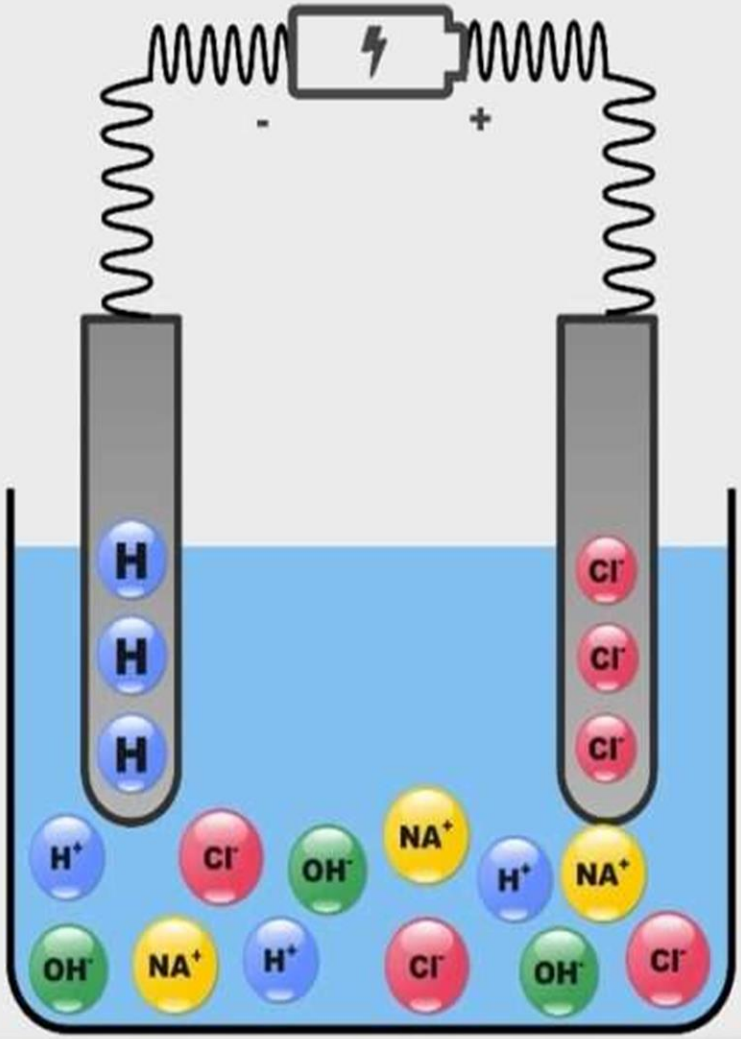
When an electric field is applied across the electrolyte (for example, by connecting the electrolyte to a battery), the positive ions are attracted to the negative electrode (cathode), while the negative ions are attracted to the positive electrode (anode). This movement of ions towards oppositely charged electrodes is called migration.

From Water:

H^+ OH^-

From Sodium Chloride :

NA^+ Cl^-



Formed at the Cathode:

H H

Formed at the Anode:

Cl Cl

Solution Left

NA OH

Salt Bridge Electrolytic Conduction Mechanism

Salt Bridge: A salt bridge is a component of an electrochemical cell that helps maintain electrical neutrality by allowing the flow of ions between the half-cells without allowing mixing of the electrolyte solutions.

The transport number **(t_i)** for a particular ion can be calculated using the ratio of the change in concentration of that ion to the total change in concentration of all ions. Mathematically, it can be expressed as:

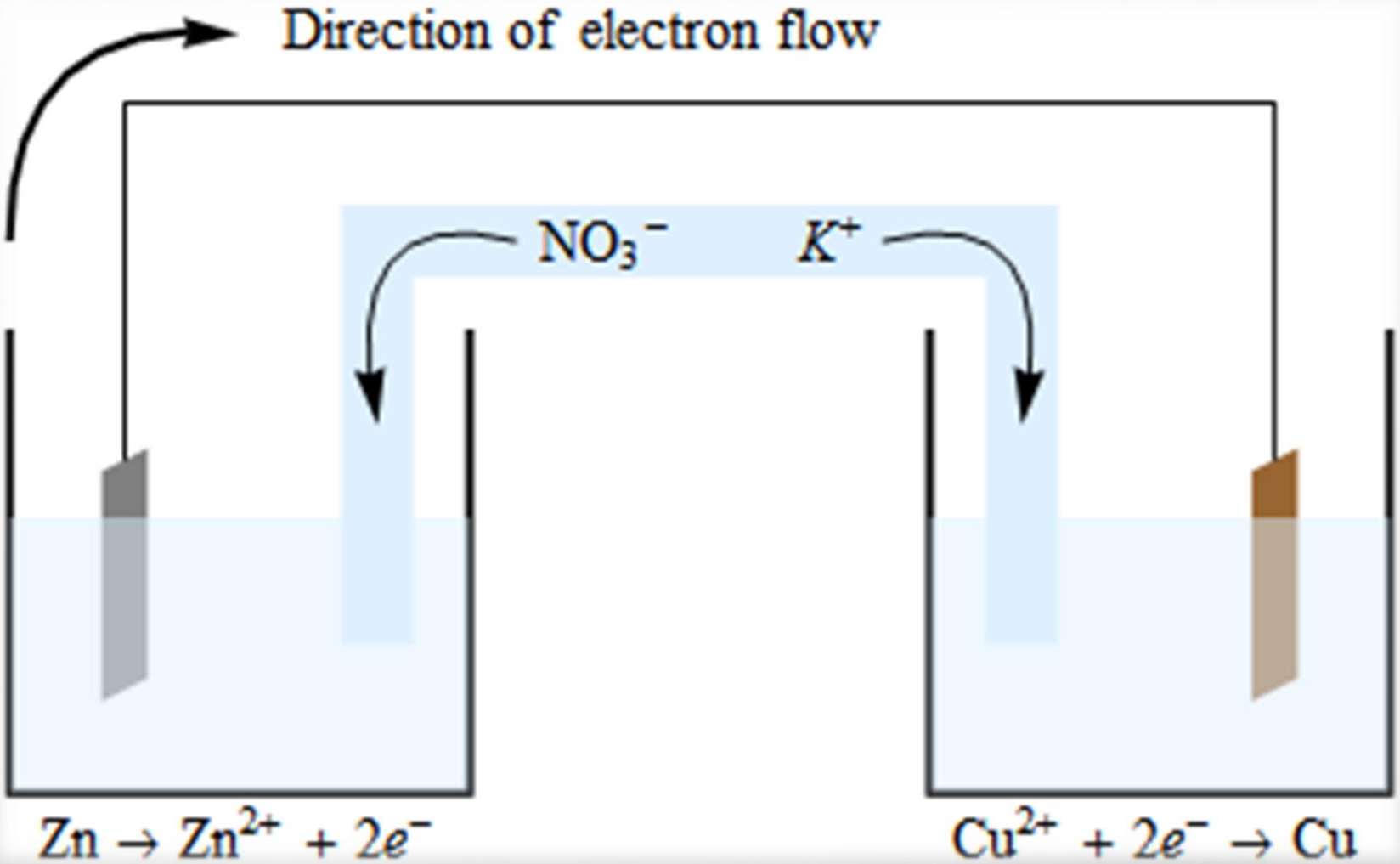
$$t_i = (\Delta C_i / \sum \Delta C)$$

Where:

ΔC_i is the change in concentration of the specific ion.

$\sum \Delta C$ is the total change in concentration of all ions.

All ionic salts can be used as electrolyte in a Salt Bridge. But some salts are used as electrolyte in salt bridge which transport number of constituent ions is 1:1. Some salts having 1:1 transport number are KCl, $NaNO_3$, NH_4NO_3, KNO_3 etc.


Direction of electron flow
NO_3^-
K^+
$Zn \rightarrow Zn^{2+} + 2e^-$
$Cu^{2+} + 2e^- \rightarrow Cu$

EMF Electromotive force refers to the voltage or electrical potential difference generated by a cell or battery when it's supplying current. It represents the driving force that pushes electric charge around a circuit. In an idealized scenario, this EMF would be constant regardless of the current drawn from the cell. However, in real-world situations, factors like internal resistance and chemical reactions within the cell can cause the actual voltage output to vary. The EMF of a cell is typically measured in volts (V).

To calculate the electromotive force (EMF) of a cell formed by two different metal electrodes in electrolytic solutions, you can use the **Nernst equation.** The Nernst equation describes the potential difference between two half-cells in an electrochemical cell. Here's the equation:

$$E = E^\circ - RT/nF\ln(Q)$$

Considering a reaction as:

$$M + N^{n+} \xrightarrow{ne^-} M^{n+} + N$$

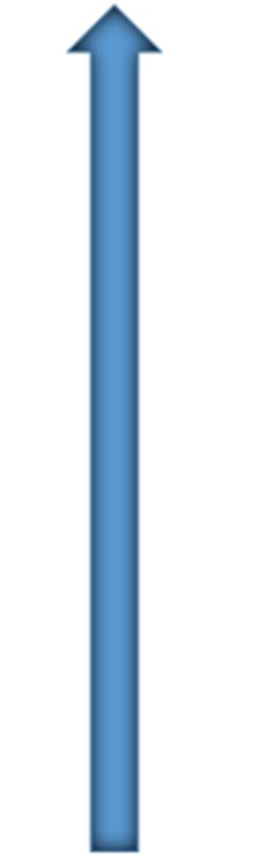
$$\text{So, } E_{cell} = E^{O}_{cell} - (0.059 / n)*\log [M^{n+}] / [N^{n+}]$$

Where,

$$RT/F = 0.059$$

How to remember the Reactivity Series?

Please	Potassium
Stop	Sodium
Calling	Calcium
Me	Magnesium
A	Aluminium
Careless	(Carbon)
Zebra	Zinc
Instead	Iron
Try	Tin
Learning	Lead
How	(Hydrogen)
Copper	Copper
Saves	Silver
Gold	Gold



How to represent a cell using salt bridge?