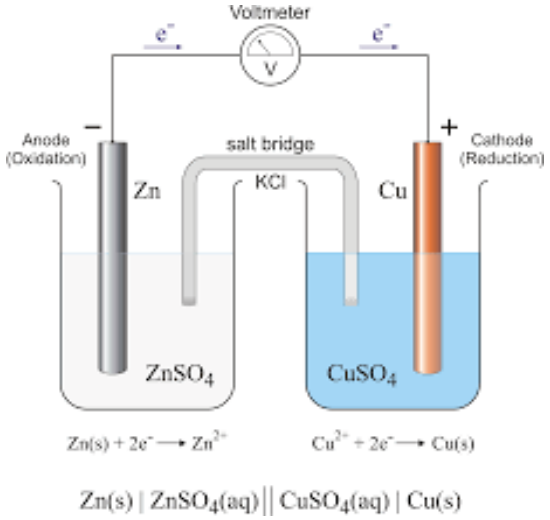
Electrochemical Cells:

An electrochemical cell is a device that generates electrical energy from chemical reactions or uses electrical energy to cause chemical reactions.

Galvanic (Voltaic) Cells:

Galvanic cell is an electrochemical cell in which the electrons transferred due to redox reaction are connected into electrical energy.

Example: Daniel cell



Galvanic cell consists of a zinc electrode dipped in 1M $ZnSO_4$ solution and a copper electrode dipped in 1M $CuSO_4$ solution. Each electrode is known as a half cell. The two solutions are interconnected by a salt bridge and the electrodes are connected by a wire through a voltmeter.

AT ANODE:

Oxidation takes place in zinc electrode by the liberation of electrons, so this electrode is called negative electrode or Anode.

AT CATHODE:

Reduction takes place in the copper electrode by the acceptance of electrons. So this electrode is called Positive electrode or Cathode.

- At cathode: $Cu^{2+} + 2e^- \rightarrow Cu$
- At anode: $Zn \rightarrow Zn^{2+} + 2e^-$

SALT BRIDGE

It consists of U tube containing saturated solution of KCl or NH_4NO_3 in agar- agar gel. It connects the two half cells of the galvanic cells.

FUNCTIONS OF SALT BRIDGE:

- It eliminates liquid junction potential.
- It provides the electrical continuity between the two half cells.

Representation of Electrochemical Cell (Galvanic Cell)

(a) The anode (negative electrode) is written on the left hand side and cathode (positive electrode) on the right hand side.

(b) The anode of the cell is represented by writing metal or solid phase and then the metal ion present in the electrolytic cell. Both are separated by a vertical line or a semicolon. For example

e.g.(i) $Zn|Zn^{2+} or Zn;Zn^{2+}$

$Zn|ZnSO_4 or Zn_{(s)}|ZnSO_4(0.1m)$

(ii) $Pt,H_2(1atm)_2|H^+(0.1M)$

(c) The cathode of the cell is represented by writing the cat-ion of theelectrolyte first and then the metal. Both are separated by a vertical line or semicolon.

$Cu^{2+}|Cu$ or Cu^{2+}; Cu or $Cu^{2+}(1M)|Cu$.

For gaseous electrode e.g. $Cl^-(1m)|Cl_2(1atm)$, $P_2|$

(d) The salt bridge which separates the two half-cell is indicated by two parallel vertical line. For example the Daniel cell can be represented as

$$Zn_{(s)}|ZnSO_{4(aq)}||CuSO_{4(aq)}|Cu_{(s)}$$

Anode Salt bridge Cathode

DIFFERENCE BETWEEN ELECTROLYTIC CELL AND ELECTROCHEMICAL CELL

ELECTROLYTIC CELL	ELECTROCHEMICAL CELL
Electrical energy is converted into chemical energy.	Chemical energy is converted into chemical energy
The anode carries (+) charges	The anode carries (-) charges
The cathode carries (-) charges	The cathode carries (+) charges
The electrons are supplied to the cell from the external battery (i.e) electron move in through cathode and comes out from anode	But electrons are drawn from the cell (i.e) electrons move from anode to cathode through external circuit.
Ex. Electroplating	Ex. Battery

Measurement of EMF-Electrolytic cell

EMFOFACELL

Definition

Electro motive force is defined as, "the difference of potential which causes flow of current from one electrode of higher potential to the other electrode of lower potential.

Thus, the emf of a galvanic cell can be calculated using the following relationship.

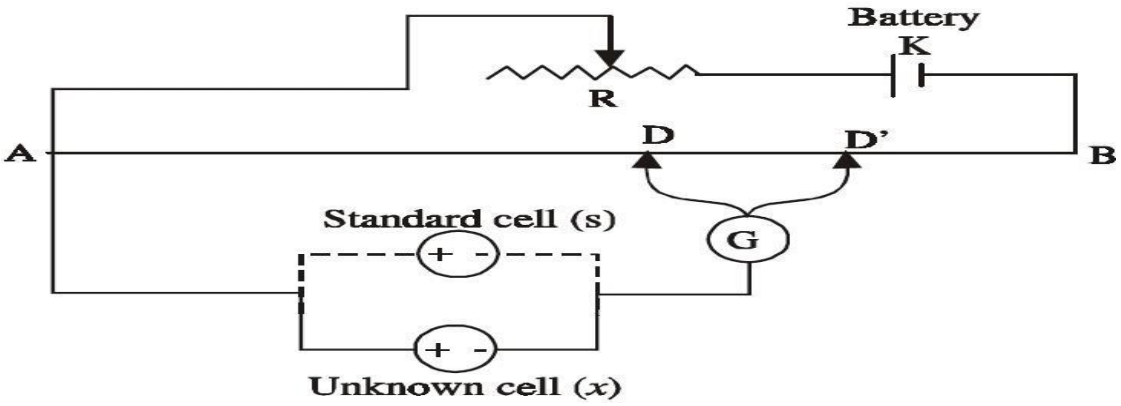
Standard EMF of the cell = [standard reduction potential of R.H.S.electrode]–

[Standard reduction potential of L.H.S.electrode]

$$E^\circ_{cell} = E^\circ_{right} - E^\circ_{left}$$

Measurement of emf of a cell

The potential difference or emf of a cell can be measured on t he basis of poggendorff's compensation principle. Here the emf of the cell is just opposed or balanced by an emf of standard cell (external emf), so that no current flows in the circuit.



The potentiometer consists of a uniform wire AB

A storage battery (K) is connected to the ends A and B of the wire through a rheostat (R).The cell of unknown emf (x) is connected in the circuit by connecting its positivepole to A and the negative pole is connected to a sliding contact (D) through agalvanometer G. The sliding contact is freely moved along the wire AB till no current flows through the galvanometer. Then the distance AD is measured. The emf of unknown cell is directly proportion al to the distance AD.

$$E_x \propto AD$$

Then the unknown cell (x) is replaced by a standard cell (s) in the circuit.The sliding contact is a gain moved till there is null deflection in the galvanometer. Then the distance AD′ is measured. The emf of standard cell Es is directly proportional to the distance AD′.

$$E_s \propto AD'$$

Then, the emf of the unknown cell can be calculated from the following equation.

$$\frac{\text{Emf of the unknown cell x}}{\text{Emf of the standard cell s}} = \frac{\text{Length AD}}{\text{Length AD'}}$$

$$\frac{E_x}{E_s} = \frac{AD}{AD'}$$

$$\therefore \text{Emf of the unknown cell} = E_x = \frac{AD}{AD'} \text{ X } E_s$$