Electrochemical cell - Galvanic cells

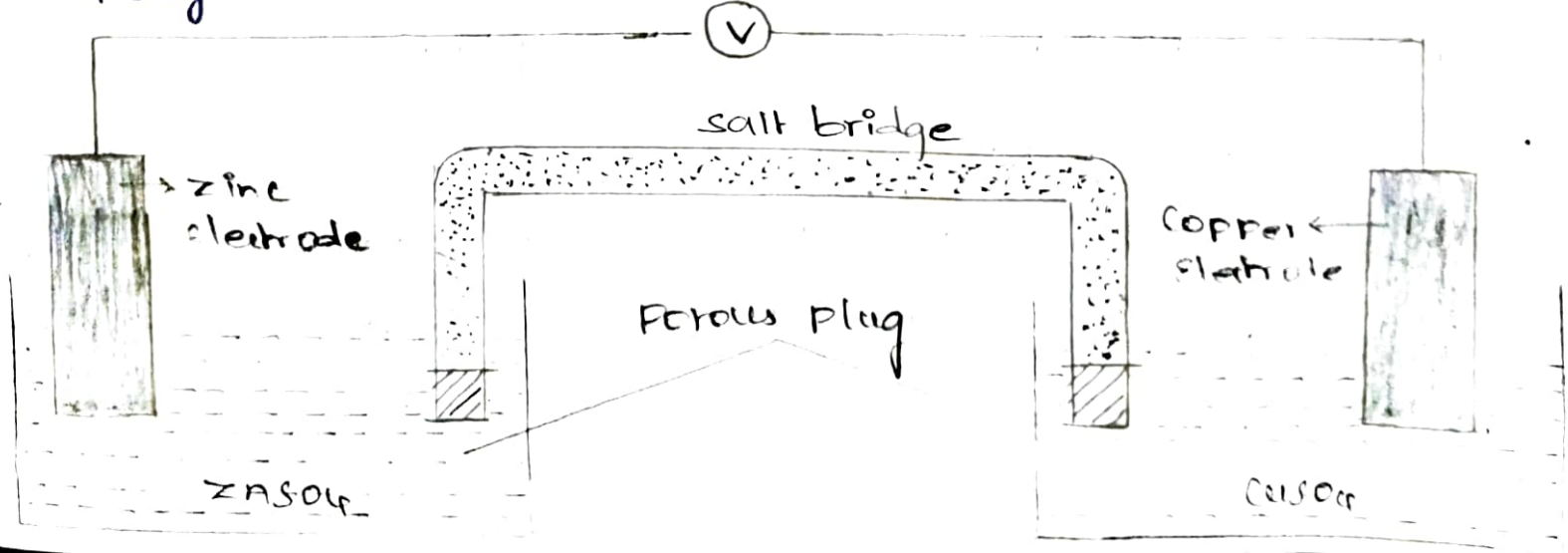
Electrochemical cells are entirely different from electrolytic cells. The cells used for electrolysis (where electrical energy is converted to chemical energy) are called electrolytic cells, whereas in Electrochemical cells, chemical energy is converted to electrical energy.

Galvanic cells are Electrochemical cells in which the electrons, transferred due to redox reaction, are converted to electrical energy.

Eg :- Daniel cell

cell device (construction)

Daniel 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 inter connected by a salt bridge and the two electrodes are connected by a wire through the voltmeter.



Reactions occuring in the cell:-

At anode:- oxidation takes place in the zinc electrode by the liberation of electrons, so this electrode is called negative electrode or anode.

At cathode:- Redution takes place in the copper electrode by the acceptance of electrons, so this electrode is called the positive electrode or cathode.

$$Zn \longrightarrow Zn^{2+} + 2e^- \quad \text{(Anode)}$$

$$Cu^{2+} + 2e^- \longrightarrow Cu \quad \text{(Cathode)}$$

$$Cu^{2+} + Zn \rightleftharpoons Zn^{2+} + Cu \quad \text{(net cell reaction)}$$

The electrons liberated by the oxidation reaction flow through the external wire and are consumed by the copper ions at the cathode.

Salt bridge:-

It consists of a 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 a galvanic cell:-

a) $Zn|Zn^{2+}$ (or) $Zn|ZnSO_4$ (or) Zn ; Zn^{2+}

b) Standard hydrogen electrode

Pt, H_2 (1 atm) ; H^+ (1M)

The cathode must be written by writing electrolyte first and then the electrode metal. These two are separated by a vertical line or a semicolon.

Eg:- $Cu^{2+}|Cu$ (or) $CuSO_4|Cu$ (or) Cu^{2+} ; Cu

The two half cells are separated by a salt bridge, which is indicated by two vertical lines.

$Zn|ZnSO_4$ (1M) $||$ $CuSO_4$ (1M) $|Cu$ (or)

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

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

EMF of a cell:-

Electromotive 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.

EMF = Standard reduction Potential of right hand side electrode − Standard reduction potential of left hand side electrode.

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