Some Commercial cells

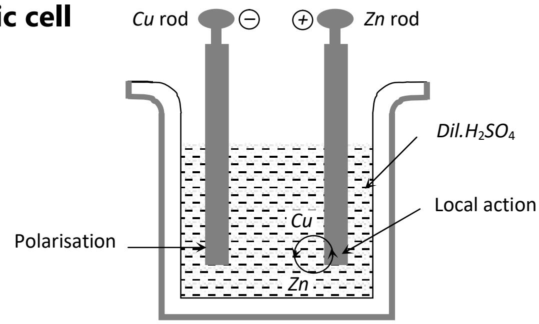
One of the main use of galvanic cells is the generation of portable electrical energy. These cells are also popularly known as **batteries.** The term battery is generally used for two or more Galvanic cells connected in series. Thus, a **battery** is an arrangement of electrochemical cells used as an energy source. The basis of an electrochemical cell is an oxidation – reduction reaction. However, for practical purposes there are some limitations to the use of redox reactions. A useful battery should also fulfil the following requirements;

- It should be light and compact so that it can be easily transported.
- It should have reasonably long life both when it is being used and when it is not used.
- The voltage of the battery should not vary appreciably during its use.

Types of commercial cells: There are mainly two types of commercial cells,

(1) **Primary cells:**In these cells, the electrode reactions cannot be reversed by an external electric energy source. In these cells, reactions occur only once and after use they become dead. Therefore, they are **not chargeable.** Some common example are, dry cell, mercury cell, Daniell cell and alkaline dry cell.

(i) **Voltaic cell**



Cathode : *Cu* rod

Anode :*Zn* rod

Electrolyte :dil. H_2SO_4

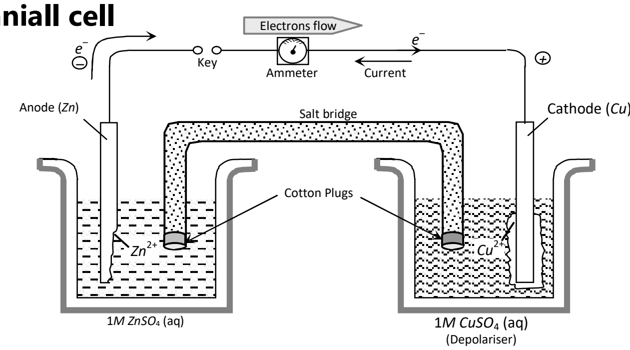
Emf :1.08 *V*

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

At Anode : $Zn \rightarrow Zn^{2+} + 2e^-$

Over all reaction : $Zn + Cu^{2+} \rightarrow Zn^{2+} + Cu$

(ii)**Daniall cell**



Cathode : *Cu* rod

Anode :*Zn* rod

Electrolyte :dil. H_2SO_4

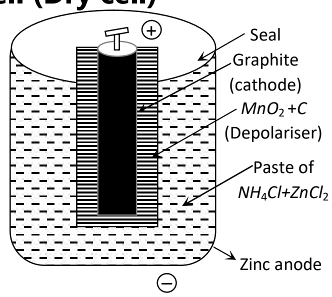
Emf:1.1 *V*

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

At Anode : $Zn \rightarrow Zn^{2+} + 2e^-$

Over all reaction : $Zn + Cu^{2+} \rightarrow Zn^{2+} + Cu$

(iii) **Lechlanche cell (Dry cell)**



Cathode : Graphite rod

Anode :*Zn* pot

Electrolyte :Paste of $NH_4Cl + ZnCl_2$ in starch

Emf :1.2 *V* to 1.5 *V*

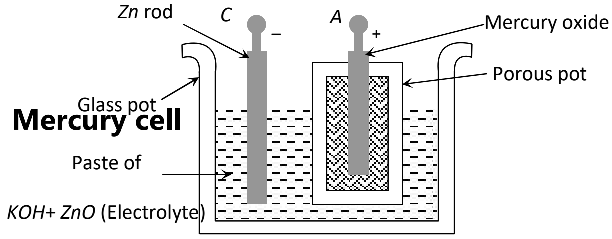
At cathode : $NH_4^+ + MnO_2 + 2e^- \rightarrow MnO(OH)^- + NH_3$

At Anode : $Zn \rightarrow Zn^{2+} + 2e^-$

Over all reaction :

$$Zn + NH_4^+ + MnO_2 \rightarrow Zn^{2+} + MnO(OH)^- + NH_3$$

(iv) **Mercury cell**



Cathode :Mercury (II) oxide

Anode : *Zn* rod

Electrolyte :Paste of $KOH + ZnO$

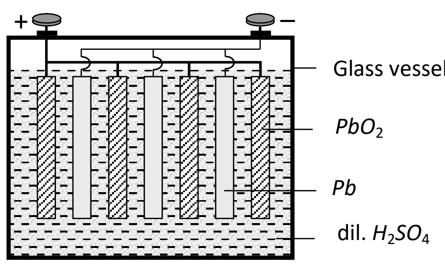
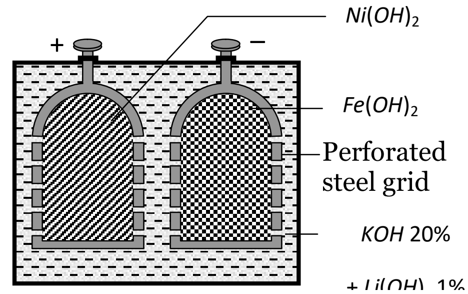
Emf:1.35 *V*

At cathode : $HgO_{(s)} + H_2O_{(l)} + 2e^- \rightarrow Hg_{(l)} + 2OH^-_{(aq)}$

Note:In a dry cell $ZnCl_2$ combines with NH_3 produced to form the complex $[Zn(NH_3)_2Cl_2]$, otherwise the pressure developed due to NH_3 would crack the seal of the cell.

Mercury cell give a constant voltage throughout its life because the electrolyte KOH is not consumed in the reaction.

(2) **Secondary cells:** In the secondary cells, the reactions can be reversed by an external electrical energy source. Therefore, these cells can be **recharged** by passing electric current and used again and again. These are also celled **storage cells.** Examples of secondary cells are, lead storage battery and nickel – cadmium storage cell.

In charged	**Lead storage cell**	**Alkali cell**
		
Positive electrode	Perforated lead plates coated with PbO_2	Perforated steel plate coated with $Ni(OH)_4$
Negative electrode	Perforated lead plates coated with pure lead	Perforated steel plate coated with Fe
Electrolyte	dil. H_2SO_4	20% solution of KOH + 1% LiOH
During charging	**Chemical reaction** **At cathode** : $PbSO_4 + 2H^+ + 2e^- \rightarrow Pb + H_2SO_4$ **At anode** : $PbSO_4 + SO_4^{--} + 2H_2O - 2e^- \rightarrow PbO_2 +$ $2H_2SO_4$ Specific gravity of H_2SO_4 increases and when specific gravity becomes 1.25 the cell is fully charged.	**Chemical reaction** **At cathode** : $Ni(OH)_2 + 2OH^+ - 2e^- \rightarrow Ni(OH)_4$ **At anode** : $Fe(OH)_2 + 2K^+ + 2e^- \rightarrow Fe + 2KOH$ **Emf of cell :** When cell is fully charged then E = 1.36 volt

	Emf of cell: When cell is fully charged then E = 2.2 volt	
During discharging	**Chemical reaction** **At cathode** : $Pb + SO_4^{--} - 2e^- \rightarrow PbSO_4$ **At anode** : $PbO_2 + 2H^+ - 2e^- + H_2SO_4 \rightarrow PbSO_4 +$ $2H_2O$ Specific gravity of H_2SO_4 decreases and when specific gravity falls below 1.18 the cell requires recharging. **Emf of cell**: When emf of cell falls below 1.9 volt the cell requires recharging.	**Chemical reaction** **At cathode** : $Fe + 2OH^- - 2e^- \rightarrow Fe(OH)_2$ **At anode** : $Ni(OH)_4 + 2K^+ + 2e^- \rightarrow Ni(OH)_2 +$ $2KOH$ **Emf of cell**: When emf of cell falls below 1.1 V it requires charging.
Efficiency	80%	60%