

Concentration cells

①

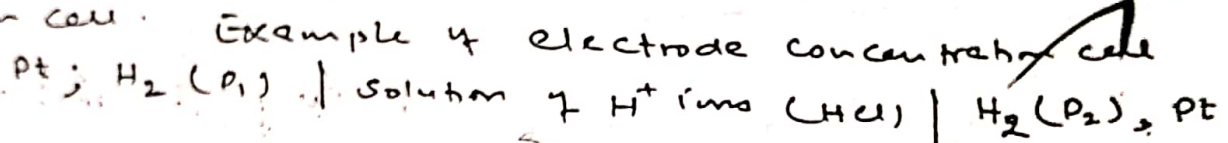
230
26/11/2024

cells in which the EMF produced is only due to the difference in concentrations of the electrodes or that of the solutions of electrolytes with which they are in contact are called concentration cells. Thus, there are two types of concentration cells -

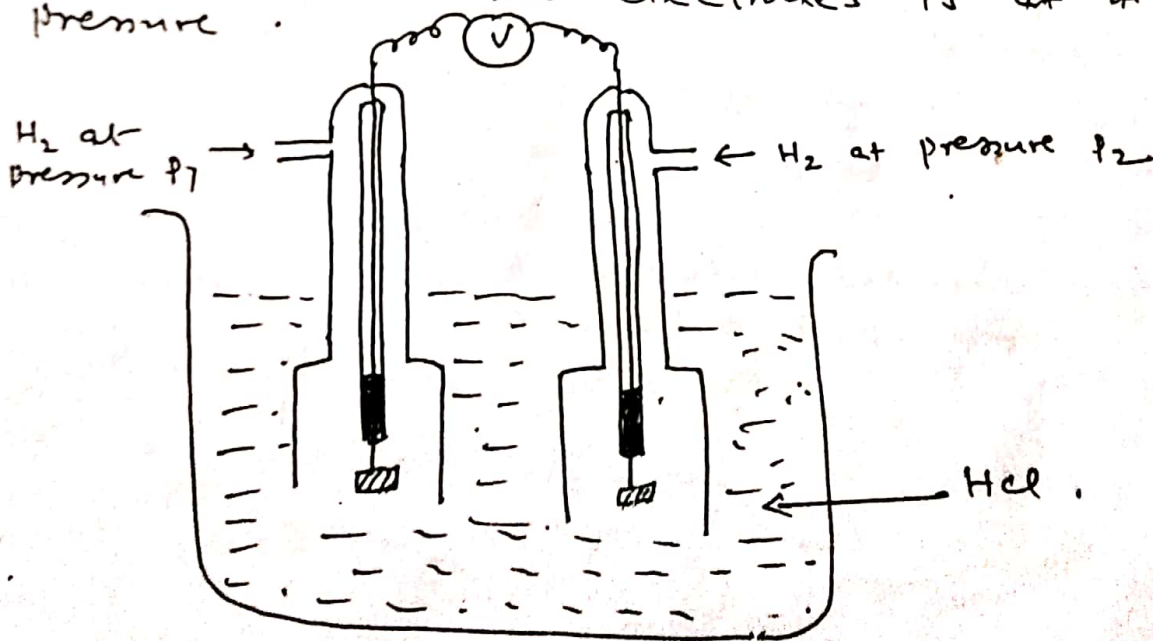
- ① Electrode concentration cells.
- ② Electrolyte concentration cells.

① Electrode concentration cells

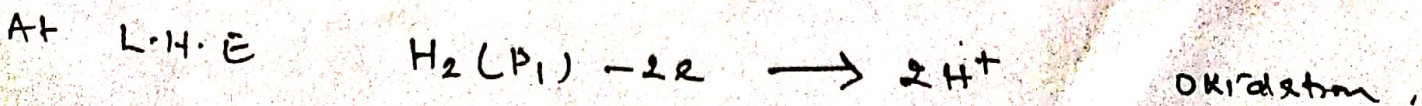
cells in which the EMF produced is only due to difference in concentration of electrodes are called electrode concentration cell.

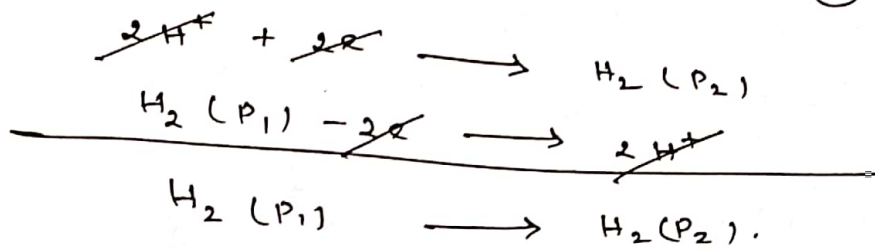


In above cell both electrodes are hydrogen electrode immersed in the same solution of H^+ ions but H_2 gas passed in two electrodes is at different pressure.



Reactions



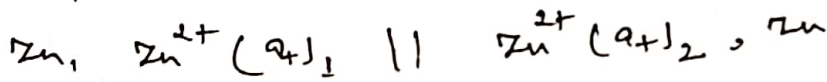


Applying Nernst equation

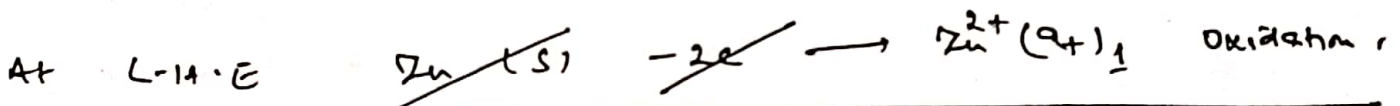
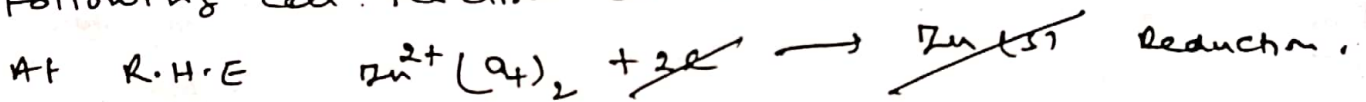
$$E = E^{\circ} - \frac{0.059}{2} \log \frac{P_2}{P_1} \text{ at } 25^{\circ}\text{C}.$$

(ii) Electrolytic concentration cell

In this type of concentration cell, the two electrodes of same metal are dipping in solutions of metal ions of different concentration.



Following cell reaction takes place



Thus, net process involves transfer of one mole of Zn^{2+} ions from solution of activity $(a_+)_2$ to solution in which activity is $(a_+)_1$.

Applying Nernst equation.

$$E_R = E^{\circ} - \frac{RT}{2F} \ln \frac{1}{(a_+)_2}$$

$$E_R = E^{\circ} + \frac{RT}{2F} \ln (a_+)_2$$

$$\text{and } E_L = E^{\circ} - \frac{RT}{2F} \ln \frac{1}{(a_+)_1}$$

$$= E^{\circ} + \frac{RT}{2F} \ln (a_+)_1$$

(3)

$$\text{EMF of the cell} = E_R - E_L$$

$$E_{\text{cell}} = \left\{ E^\circ + \frac{RT}{2F} \ln (a_+)_2 \right\} - \left\{ E^\circ + \frac{RT}{2F} \ln (a_+)_1 \right\}$$

$$E_{\text{cell}} = \cancel{E^\circ} + \frac{RT}{2F} \ln (a_+)_2 - \cancel{E^\circ} - \frac{RT}{2F} \ln (a_+)_1$$

$$E_{\text{cell}} = \frac{RT}{2F} \ln \frac{(a_+)_2}{(a_+)_1}$$

For feasible process EMF should be positive.
Hence $(a_+)_2 > (a_+)_1$