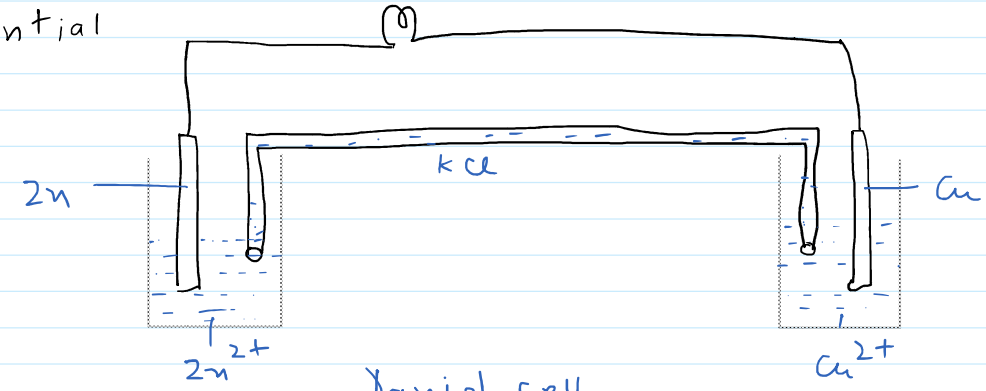
Cell potential



Daniel cell

Anode

Reaction

$Zn(s) \longrightarrow Zn^{2+}(aq) + 2e^-$

Electrode Potential : $E_{Zn/Zn^{2+}}$

If $[Zn^{2+}] = 1M$, then potential is called standard electrode potential ($E^\circ_{Zn/Zn^{2+}}$)

$E_{Zn^{2+}/Zn} = -E_{Zn/Zn^{2+}}$

Cathode

Reaction

$Cu^{2+}(aq) + 2e^- \rightarrow Cu(s)$

Electrode Potential : $E_{Cu^{2+}/Cu}$

If $[Cu^{2+}] = 1M$, then potential is called standard electrode potential ($E^\circ_{Cu^{2+}/Cu}$)

$$E_{cell} = E_{reduction}(cathode) + E_{oxidation}(anode)$$

$$E_{cell} = E_{Cu^{2+}/Cu} + E_{Zn/Zn^{2+}}$$

$$E^\circ_{cell} = E^\circ_{Cu^{2+}/Cu} + E^\circ_{Zn/Zn^{2+}}$$

$$E_{cell} = E_{reduction}(cathode) - E_{reduction}(anode)$$

$$E_{cell} = E_{cathode} - E_{anode}$$

$$E_{cell} = E_R - E_L$$

Standard conditions, conc: 1M, pressure = 1bar

Electrode potential at standard conditions is experimentally

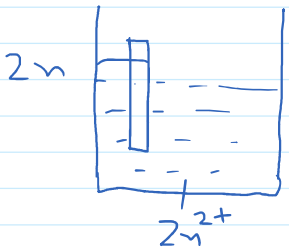
determide, Generally measurement is done at 298k.

Nernst equation

This equation tells about variation of electrode/cell potential with variation is concentration or pressure.

Electrode

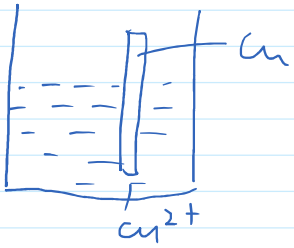
$$E_{cell/electrode} = E^{\circ}_{cell/Electrode} - \frac{2.303RT}{nF} \log Q$$



n = no. of e^- exchanged in chemical reaction

T → Temp

F → Faraday = 96500 C



$Zn(s) \rightarrow Zn^{2+}(aq) + 2e^-$

$Cu^{2+}(aq) + 2e^- \rightarrow Cu$

$$E_{Zn/Zn^{2+}} = E^{\circ}_{Zn/Zn^{2+}} - \frac{2.303RT}{nF} \log [Zn^{2+}]$$

$$E_{Cu^{2+}/Cu} = E^{\circ}_{Cu^{2+}/Cu} - \frac{2.303RT}{nF} \log \frac{1}{[Cu^{2+}]}$$

$$E_{cell} = E_{Cu^{2+}/Cu} + E_{Zn/Zn^{2+}}$$

$$= \left(E^{\circ}_{Cu^{2+}/Cu} + E^{\circ}_{Zn/Zn^{2+}}\right) - \left(\frac{2.303RT}{nF} \log [Zn^{2+}] + \frac{2.303RT}{nF} \log \frac{1}{[Cu^{2+}]}\right)$$

$$E_{cell} = E^{\circ}_{cell} - \frac{2.303RT}{nF} \log \frac{[Zn^{2+}]}{[Cu^{2+}]}$$

Cell

$$Zn(s) + Cu^{2+}(aq) \rightarrow Zn^{2+}(aq) + Cu(s)$$

$$E_{cell} = E^{\circ}_{cell} - \frac{2.303RT}{nF} \log \frac{[Zn^{2+}]}{[Cu^{2+}]}$$

Generally $T = 298\ k$, $\frac{2.303RT}{F} = \frac{2.303 \times 8.314 \times 298}{96500}$

$= 0.059$

$$E_{cell} = E^{\circ}_{cell} - \frac{0.059}{n} \log Q \quad (at\ 298k)$$