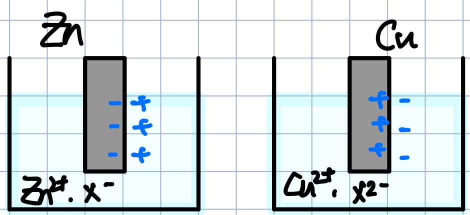
5. Standard electrode potential & Formal potential

① Renew

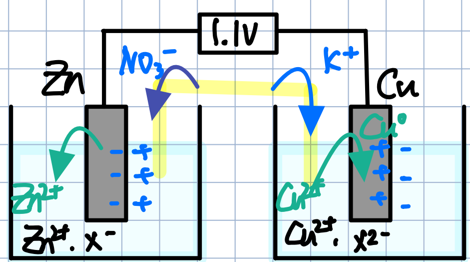
→ General form of Nernst potential → { half cell + half cell? / 전위의 정의?

② Salt bridge & standard electrode potential



→ Can we measure the each half cell's potential?

∴ 최소 2개의 half cell 필요!



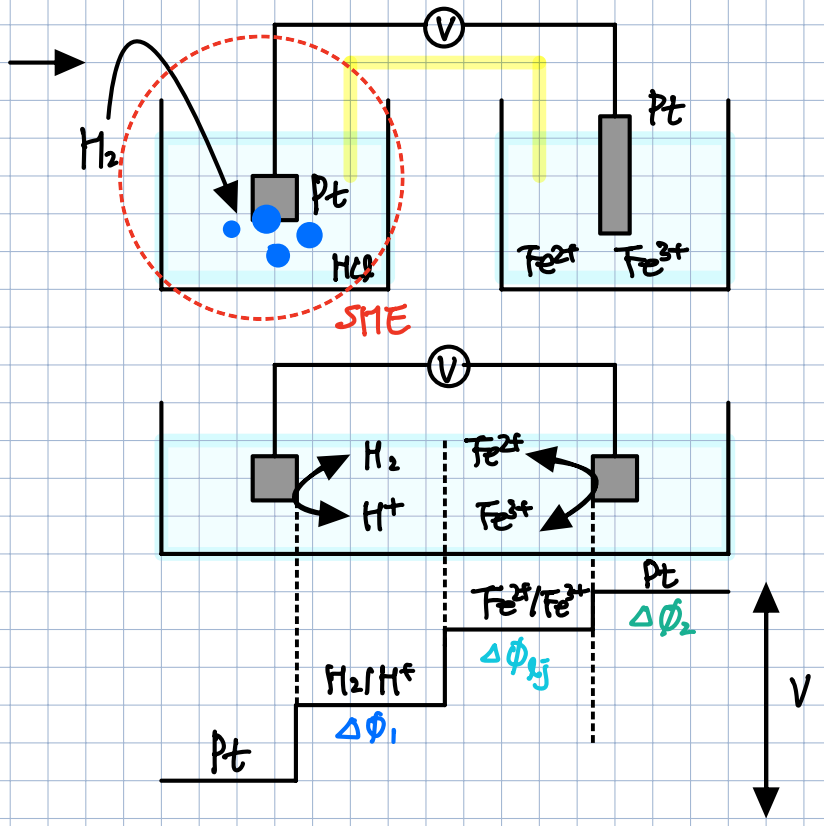
- $Zn \rightarrow Zn^{2+} + 2e^-$ (anode)

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

- cell notation : $Zn | Zn^{2+} || Cu^{2+} | Cu$
  - ↳ | : phase boundary , || : overall cell potential에 영향X phase boundary (∵ 액간전위)
  - ↳ salt bridge : to maintain electrical neutrality (saturated KCl, KNO_3, ⋯)

→ Standard cell potential : standard hydrogen electrode (SHE) : $Pt | H_2 | H^+$ half cell

= Normal hydrogen electrode (NHE)



- $V = \Delta\phi_1 + \Delta\phi_{lj} + \Delta\phi_2$

$= \Delta\phi(Pt|H_2, H^+) + \Delta\phi_{lj} + \Delta\phi(Pt|Fe^{2+}, Fe^{3+})$

$\equiv 0$ ($\because$ SHE)

$= \Delta\phi(Pt|Fe^{2+}, Fe^{3+})$ (C vs. NHE)

- $V = \Delta\phi(Pt|Fe^{2+}, Fe^{3+})$

$= \Delta\phi^{\circ}(Pt|Fe^{2+}, Fe^{3+}) + \frac{RT}{F}\ln\frac{a^s_{Fe^{3+}}}{a^s_{Fe^{2+}}}$

③ Formal potential

- $O + ne \longrightarrow R$,

$$E = E^{\circ} + \frac{RT}{nF}\ln\frac{a_O}{a_R} = E^{\circ} - \frac{RT}{nF}\ln\frac{a_R}{a_O}$$

$a_i = \gamma_i \frac{C_i}{C^{\circ}}$

$$= E^{\circ} + \frac{RT}{nF}\ln\frac{\gamma_O C_O}{\gamma_R C_R} = E^{\circ} + \frac{RT}{nF}\ln\frac{\gamma_O}{\gamma_R} + \frac{RT}{nF}\ln\frac{C_O}{C_R} = E^{\circ\prime} + \frac{RT}{nF}\ln\frac{C_O}{C_R}$$

(formal potential)

$$\therefore E_{eq} = E^{\circ\prime} + \frac{RT}{nF}\ln\frac{C_O}{C_R} \left(= E^{\circ} - \frac{0.059}{n}\log\frac{C_R}{C_O}\right)$$

(이때, $\gamma_O \approx \gamma_R$ 이면 $\frac{RT}{nF}\ln\frac{\gamma_O}{\gamma_R} \approx 0$, $\therefore E^{\circ\prime} \approx E^{\circ}$)