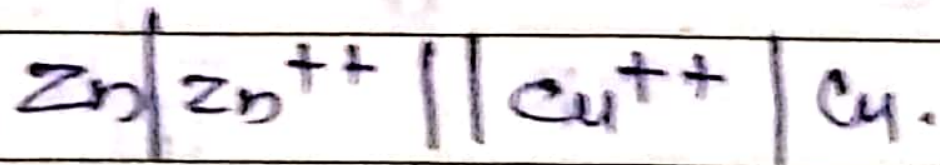


* Applications — Nernst Equation —

(1) Calculation of emf of the cell.



On applying Nernst eqⁿ —

$$E = E^{\circ} - \frac{0.0591}{2} \log \frac{[\text{Cu}] [\text{Zn}^{++}]}{[\text{Zn}] [\text{Cu}^{++}]}$$

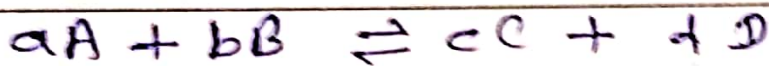


In the standard state, the activity of a solid is taken as unity.

$$\therefore E = E^{\circ} - \frac{0.0591}{2} \log \frac{[Zn^{++}]}{[Cu^{++}]}$$

② calculation of equilibrium constant

consider a equilibrium reaction -



$$K_c = \frac{[C]^c [D]^d}{[A]^a [B]^b}$$

The Nernst eqⁿ may be represented as -

$$E_{cell} = E_{cell}^{\circ} - \frac{0.0591}{n} \log \frac{[C]^c [D]^d}{[A]^a [B]^b}$$

At equilibrium -

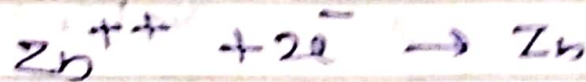
$$E_{cell} = 0$$

$$0 = E_{cell}^{\circ} - \frac{0.0591}{n} \log K_c$$

$$\therefore E_{cell}^{\circ} = \frac{0.0591}{n} \log K_c$$



③ Calculation of the single electrode potential. -



$$E = E^{\circ} - \frac{RT}{nF} \ln \frac{[\text{Zn}]}{[\text{Zn}^{++}]}$$

$$= E^{\circ} - \frac{RT}{nF} \ln \frac{1}{[\text{Zn}^{++}]}$$

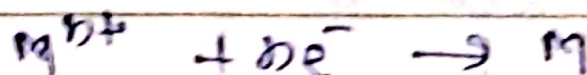
$$E = E^{\circ} + \frac{RT}{nF} \ln [\text{Zn}^{++}]$$

If concentration of 'Zn' is unity.

$$E = E^{\circ} + \frac{RT}{nF} \ln [\text{Zn}^{++}]$$

$$E = E^{\circ} + \frac{0.0591}{n} \log [\text{Zn}^{++}]$$

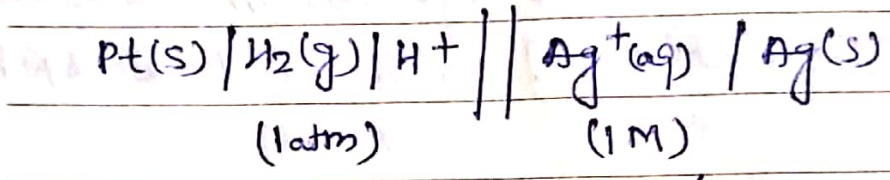
In general -



$$E = E^{\circ} + \frac{0.0591}{n} \log [M^{n+}]$$

Notes

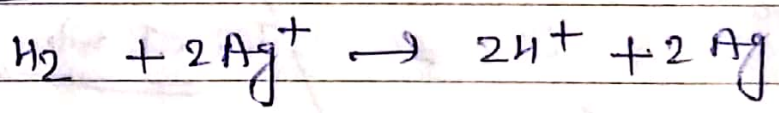
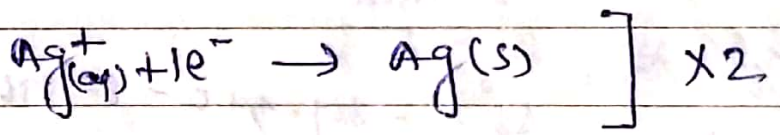
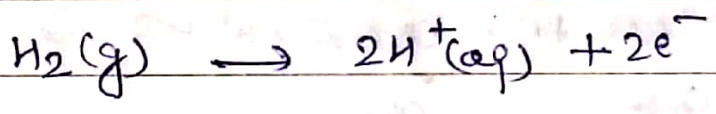
4. To find out the pH of a solution:-
Nernst equation is also used to find out the pH of a solution.



Gives, $E = 0.900 V$ (at 298 K)

$$E^\circ_{Ag^+/Ag} = 0.80V, \quad E^\circ_{2H^+/H_2} = 0.$$

The cell reaction is -



$n = 2$

$$E^\circ_{cell} = 0.80V - 0 = 0.80V$$

$$E_{cell} = E^\circ_{cell} - \frac{0.0591}{n} \log \frac{[H^+]^2}{p_{H_2} + [Ag^+]^2}$$

$$E_{cell} = E^\circ_{cell} - \frac{0.0591}{2} \log \frac{[H^+]^2}{1 \text{ atm} + 1 M^2}$$

Notes

$$E_{cell} = E_{cell}^{\circ} - \frac{0.0591}{2} \log [H^+]^2$$

$$\text{or } \log [H^+]^2 = (E_{cell} - E_{cell}^{\circ}) \times \frac{2}{0.0591}$$

$$= (0.80V - 0.900V) \times \frac{2}{0.0591}$$

$$= -0.10V \times \frac{2}{0.0591}$$

$$\log [H^+]^2 = -3.381$$

$$2 \log [H^+] = -3.381$$

$$\log [H^+] = \frac{-3.381}{2} = -1.6905$$

• taking -ve sign both sides

$$-\log [H^+] = -(-1.6905)$$

$$pH = 1.6905$$

$$pH \approx 1.7$$