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(14) $\Delta G^\circ_r = -12 \times F\,(2.73)$

$= \underline{\Delta G_f(Pr)} - \Delta G_f(R)$

$H^+ + Ag \longrightarrow Ag^+ + \frac{1}{2} H_2$

$= E^\circ_{H^+/H_2} + E_{Ag/Ag^+}$

$= 0 - 0.8$

(23)

$[Zn^{2+}] = 0.1 \times \frac{20}{100}$

(24)

$Cu(OH)_2 \longrightarrow Cu^{2+} + 2OH^-$

$S \qquad (1+2s)$

(27) $E = E^\circ - \frac{0.06}{2} \log \frac{[Zn^{2+}]}{[Ag^+]^2}$

$10^{-19} = (S)(1+2S)^2$

$10^{-19} = S = [Cu^{2+}]$

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(30)

$$Pt \mid H_2 \mid HB \parallel HA \mid H_2 \mid Pt$$

$$H_2 \longrightarrow (2H^+)_a + 2e^-$$

$$2e^- + (2H^+)_c \longrightarrow H_2$$

HA HB

$$[H^+] = \sqrt{K_a C}$$

$$E_{cell} = E^\circ_{cell} - \frac{0.06}{2} \log \left(\frac{[H^+]_a}{[H^+]_c} \right)^2$$

$$- \frac{0.06}{2} \log \frac{K_{a_1} C}{K_{a_2} C}$$

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$Ag_{(s)} \longrightarrow Ag^+ + e^-$ — E°_{Ag/Ag^+} — ΔG_1

$Ag^+ + Cl^- \longrightarrow AgCl$ — $1/K_{sp}$ — ΔG_2

$Ag_{(s)} + Cl^-(aq) \longrightarrow AgCl(s) + e^-$ — $E^\circ_{Ag,Cl^-/AgCl}$ — ΔG_3

$E^\circ_{Ag,Cl^-/AgCl} = E^\circ_{Ag/Ag^+} - \frac{0.06}{n}\log K_{sp}$ — (2)

Q $(Ag\,|\,AgCl\,|\,Cl^-(0.1M)\,\|\,Cu^{2+}(0.1M)\,|\,Cu)$

$E_{Ag,Cl^-/AgCl} = E^\circ_{Ag/Ag^+} - \frac{0.06}{n}\log\frac{K_{sp}}{[Cl^-]}$

⇒ Case-I If $E^\circ_{Ag,Cl^-/AgCl}$ is given

$E_{oxid} = E_{Ag,Cl^-/AgCl} = E^\circ_{Ag,Cl^-/AgCl} - \frac{0.06}{n}\log\frac{1}{[Cl^-]}$ — (1)

⇒ Case-II if E°_{Ag/Ag^+} & $K_{sp}(AgCl)$ are given

$\Delta G_3 = \Delta G_1 + \Delta G_2$

$-nFE^\circ_{Ag,Cl^-/AgCl} = -nFE^\circ_{Ag/Ag^+} - RT\ln 1/K_{sp}$

Short cut

(S-I) $Ag\,|\,Ag^+\,\|\,Cu^{2+}\,|\,Cu$

(S-II) $[Ag^+] = \frac{K_{sp}}{[Cl^-]}$

$Ag \longrightarrow Ag^+ + e^-$

$E_{oxid} = E^\circ_{Ag/Ag^+} - \frac{0.06}{n}\log\frac{K_{sp}}{[Cl^-]}$

Q. $Ag \mid AgCl \mid Cl^-(0.1M) \,||\, Cu^{2+}(0.1M) \mid Cu$

$E^0_{Ag/Ag^+} = -0.2$ volt $E^0_{Cu^{2+}/Cu} = 0.4$ volt

$K_{sp}(AgCl) = 10^{-10}$

Step-1 $Ag \mid Ag^+ \,||\, Cu^{2+}(0.1M) \mid Cu$

Step-2 $[Ag^+] = \frac{K_{sp}}{[Cl^-]} = 10^{-9}$

Step-3 $2Ag \longrightarrow 2Ag^+ + 2e^-$

$Cu^{2+} + 2e^- \longrightarrow Cu$

$$E_{cell} = 0.2 - \frac{0.06}{2}\log\frac{10^{-18}}{0.1}$$

$$= 0.2 - 0.03(-17) = 0.71$$

Q $Pb \mid PbCl_2 \mid Cl^-_{(0.1M)} \,||\, Cl^-_{(0.01M)} \mid AgCl \mid Ag$

$E^0_{Pb/Pb^{2+}} = 0.5$ $E^0_{Ag^+/Ag} = 0.8$

$K_{sp}(PbCl_2) = 10^{-12}$ $K_{sp}(AgCl) = 10^{-10}$

S-1 $Pb \mid Pb^{2+} \,||\, Ag^+ \mid Ag$

S-2 $[Pb^{2+}] = \frac{10^{-12}}{(0.1)^2} = 10^{-10}$ $[Ag^+] = \frac{10^{-10}}{0.01} = 10^{-8}$

$Pb \longrightarrow Pb^{2+} + 2e^-$

$2Ag^+ + 2e^- \longrightarrow 2Ag$

$$E = 1.3 - \frac{0.06}{2}\log\frac{10^{-10}}{10^{-16}}$$

$$= 1.3 - 0.03 \times 6 = 1.3 - 0.18 = 1.12$$

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Q. $Ag \mid Ag_2CrO_4(s) \mid CrO_4^{2-}(0.1M) \parallel S^{2-}(0.1M) \mid PbS \mid Pb$

$E^\circ_{Ag/Ag^+} = -0.2$ volt

$E^\circ_{PbS/Pb,S^{2-}} = 0.8$

$K_{sp}(Ag_2CrO_4) = 10^{-13}$

$K_{sp}(PbS) = 10^{-11}\ M$

$[Ag^+]^2 = \frac{10^{-13}}{0.1}$

$[Ag^+] = 10^{-6}$

$Ag \mid Ag^+ \parallel S^{2-}(0.1M) \mid PbS \mid Pb$

$2Ag \longrightarrow 2Ag^+ + 2e^-$

$PbS + 2e^- \longrightarrow Pb + S^{2-}$

$$E_{cell} = 0.6 - \frac{0.06}{2}\log\frac{10^{-12} \times 0.1}{1}$$

$$= 0.6 + 0.03 \times 13 = 0.99$$

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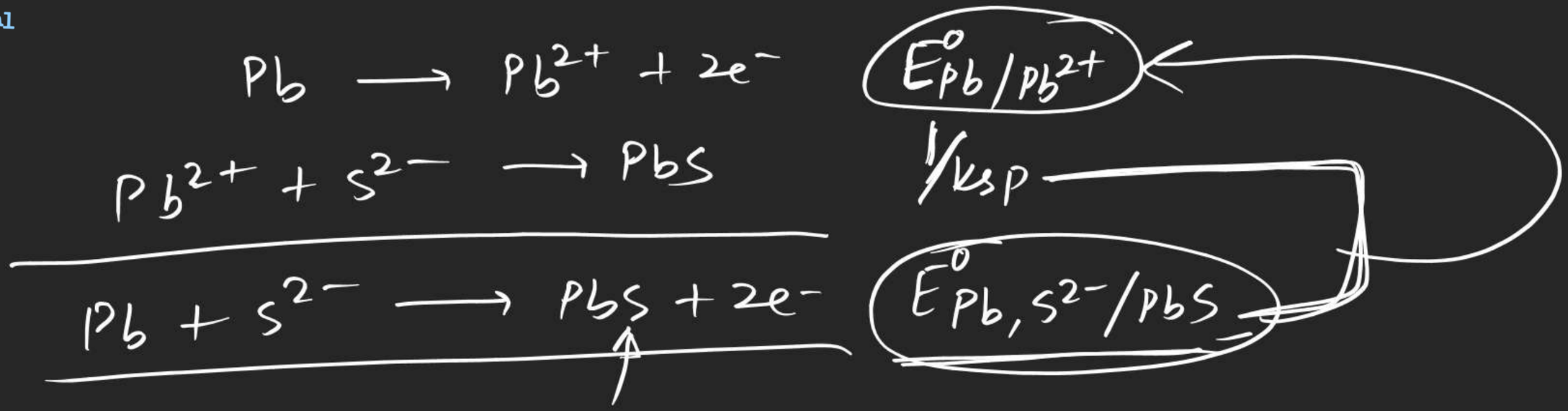

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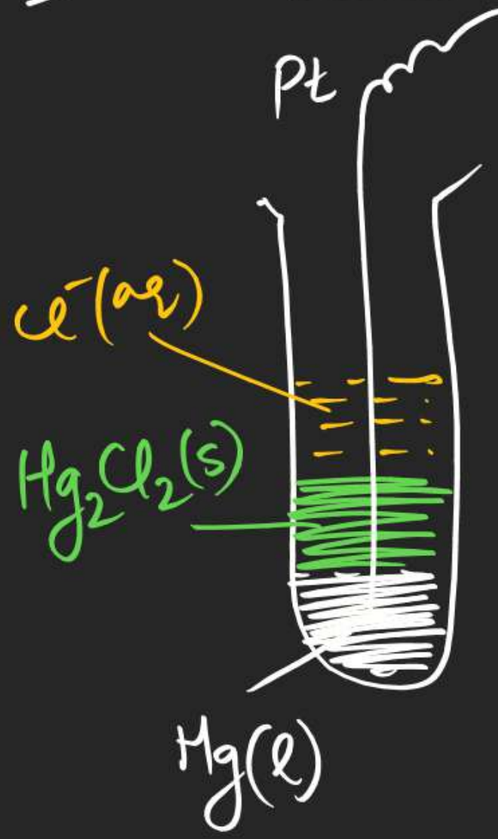
e.g. **Calomel electrode**



$$Pt \,|\, Hg(\ell) \,|\, Hg_2Cl_2 \,|\, Cl^- \,\|$$

$$2Hg \longrightarrow Hg_2^{2+}{}_{(aq)} + 2e^-$$

$$Hg_2^{2+} + 2Cl^- \longrightarrow Hg_2Cl_2(s)$$

$$K_{sp} = [Hg_2^{2+}][Cl^-]^2$$

$$2Hg(\ell) + 2Cl^- \longrightarrow Hg_2Cl_2(s) + 2e^-$$

O-I	40 – 45
S-I	31 – 37

Bihar	1 – 14 Feb
Mp	6 – 27 Feb
Up	
Odisa	15 feb – 15 March
Mana	24 Feb – 23 March
WB	15 feb – 27 Feb
Gujrat	14 March – 25 March