5-II (leader)

1. $H_2 \longrightarrow 2H^+ + 2e^\ominus$

$2e^\ominus + 2H^+ \longrightarrow H_2$

$H_2 + 2H^+ \longrightarrow 2H^+ + H_2$

$$\mathcal{E} = \underset{0}{\mathcal{E}^\circ} - \frac{.059}{2} \log \frac{[H^+)^2_{anod}}{[H^+)^2_{cathod}}$$

$$[H^+]_{anode} = \sqrt{K_a c} = \sqrt{1.8 \times 10^{-5} \times 10^{-1}}$$

$$[OH^\ominus]_{cathode} = \sqrt{K_b c} = \sqrt{1.8 \times 10^{-5} \times .01}$$

$$[H^+]_{cathod} = \frac{10^{-14}}{\sqrt{1.8 \times 10^{-7}}}$$

$$\mathcal{E} = -.059 \log \frac{[H^+)_{anode}}{[H^+)_{cathod}}$$

$$\mathcal{E} = -.059 \log \frac{\sqrt{1.8 \times 10^{-6}}}{\frac{10^{-14}}{\sqrt{1.8 \times 10^{-7}}}}$$

$$\mathcal{E} = -.059 \log \frac{1.8 \times 10^{-6} \times \sqrt{10^{-1}}}{10^{-14}}$$

$$\mathcal{E} = -.059 \log \frac{1.8}{\sqrt{10}} \times 10^{-8}$$

$$\mathcal{E} = -.059 \left[-8 - \frac{1}{2} + \log(1.8)\right] = .46 \text{ volt}$$

Q.2

(i) $Fe_{(s)} + 2OH^{\ominus} \rightleftharpoons FeO_{(s)} + H_2O_{(l)} + 2e^{\ominus}$ $E^\circ = .87$

$Ni_2O_{3(s)} + H_2O_{(l)} + 2e^{\ominus} \rightleftharpoons 2NiO_{(s)} + 2OH^{\ominus}$ $E^\circ = 0.40$

$Fe_{(s)} + Ni_2O_{3(s)} \rightleftharpoons FeO_{(s)} + 2NiO_{(s)}$ $E^\circ = 1.27$

(ii) E.m.f of cell $E = E^\circ = 1.27$ because active mass of all the species is equal to 1. Cell potential will not depend on concentration of KOH because it is not present in net cell reaction

(iii) maximum amount of electrical Energy ⇒ $\Delta G = -nFE$

$$\Delta G = \frac{-2 \times 96500 \times 1.27}{1000} \text{ Joul.}$$

$$\Delta G = -245.11 \text{ Joule.}$$

3.

$$Cu(OH)_2 \rightleftharpoons Cu^{+2} + 2OH^{\ominus}$$

s $\quad$ 1 $\quad$ {[pOH = 0]}

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

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

$2e^{\ominus} + Cu^{+2}_{(aq.)} \longrightarrow Cu_{(s)}$

$$\mathcal{E} = 0.34 - \frac{.059}{2} \log \frac{1}{[Cu^{+2}]}$$

$$\mathcal{E} = 0.34 - \frac{.059}{2} \log 10^{19}$$

$$\mathcal{E} = 0.34 - \frac{.059}{2} \times 19$$

$$\mathcal{E} = -0.2205 \text{ Volt}$$

4. $Ag \rightarrow Ag^{+} + e^{\ominus}$

$e^{\ominus} + Ag^{+} \longrightarrow Ag$

$Ag + Ag^{+} \longrightarrow Ag^{+} + Ag$

$$\mathcal{E} = 0 - \frac{.059}{1} \log \frac{[Ag^{+}]_{anode}}{.05}$$

$$0.788 = -.059 \log \frac{[Ag^{+}]_{anode}}{.05}$$

$$4.4 \times 10^{-14} = \frac{[Ag^{+}]_{anode}}{.05}$$

$$2.2 \times 10^{-15} = [Ag^{+}]_{anode}$$

$$K_{sp}(AgI) = [Ag^{+}][I^{\ominus}]$$

$$= 2.2 \times 10^{-15} \times .05 = 1.1 \times 10^{-16}$$

Q.5 Two parallel reaction are going in the cell

$$H_2O + H_2SO_4 \longrightarrow H_2 + H_2S_2O_8$$

and

$$H_2O \longrightarrow H_2 + O_2$$

$$Eq.(H_2) = Eq.(O_2) + Eq.(H_2S_2O_8)$$

$$\frac{9.722}{22.7} \times 2 = \frac{2.35}{22.7} \times 4 + n_{H_2S_2O_8} \times 2$$

$$0.8565 = 0.4140 + n_{H_2S_2O_8} \times 2$$

$$n_{H_2S_2O_8} = 0.22125 \text{ mol}$$

mass of $H_2S_2O_8 = 0.22125 \times 194 = 42.92$ gm.

Q.6 Let percentage efficiency $= x\%$

$$Eq.(Cu^{+2}) = \frac{It}{96500} \times \frac{x}{100}$$

$$\frac{3}{63.5} \times 2 = \frac{3 \times 2 \times 3600}{96500} \times \left(\frac{x}{100}\right)$$

$$x = 42.21\%$$

Q.7 $\lambda_{eq} = \frac{k \times 1000}{N}$

$97.1 = \frac{k \times 1000}{0.1}$

$k = 0.00971$ mho cm^{-1}

$\frac{1}{R} \cdot \frac{l}{A} = 0.00971$

$\frac{1}{R} \times \frac{0.5}{1.5} = 0.00971$

$\frac{1}{R} = 0.02913$ ohm.

$I = \frac{V}{R} = 5 \times .02913 = 0.14565$ Amplier

Q.8 $k = \frac{1}{R} \cdot \frac{l}{A}$

$1.342 = \frac{1}{170.5} \times \frac{l}{1.86 \times 10^{-4}}$

$l = 0.0424$ meter

Q.9.

$$E = 0 - \frac{.0591}{2} \log \frac{C_2}{C_1}$$

$$E = -\frac{.0591}{2} \log \frac{1}{10}$$

$$E = 0.0295 \text{ Volt}$$

Q.10. volume of Ag layer $= 80 \times 5 \times 10^{-6} \times 100$ c.m.^{3}

$$= 4 \times 10^{-2} \text{ c.m}^3$$

mass of Ag layer $= 4 \times 10^{-2} \times 10.8$

$$= 4.32 \text{ gm} \quad .432 \text{ gm}$$

Eq. Ag $= \frac{It}{96500}$

$$\frac{0.432}{108} \times 1 = \frac{2 \times t}{96500}$$

$$t = 193 \text{ sec.}$$