

$E_{\text{cell}}^{\circ} = 3.17\text{V}$ [Galvanic cell] Find E_{cell}

Sol: Here, $n = 2$
 $E_{\text{cell}}^{\circ} = 3.17\text{V}$

$$E_{\text{cell}} = E_{\text{cell}}^{\circ} - \frac{0.0591}{2} \log \frac{[\text{Mg}^{2+}]}{[\text{Ag}^{2+}]^2} \quad \begin{matrix} [\because 1\text{Mg}^{2+}] \\ [\because 2\text{Ag}^{2+}] \end{matrix}$$

$$= 3.17 - \frac{0.0591}{2} \log \left(\frac{0.13}{(0.0001)^2} \right)$$

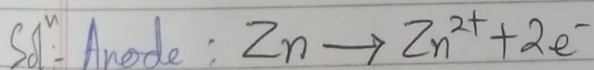
$$= 3.17 - 0.02955 \times 7.114$$

$$= 3.17 - 0.21$$

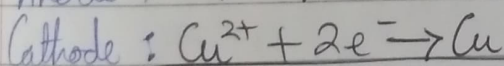
$$\Rightarrow E_{\text{cell}} = 2.96\text{V}$$

Q2. Calculate Equilibrium constant (K) for Daniel cell

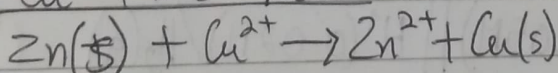
$E_{\text{cell}}^{\circ} = 1.1\text{V}$ Find E_{cell}



Here, $n = 2$



$$E_{\text{cell}}^{\circ} = 1.1\text{V}$$



At EQ^m, $E_{\text{cell}} = 0$

$$E_{\text{cell}} = E_{\text{cell}}^{\circ} - \frac{0.0591}{n} \log K$$

$$\Rightarrow 0 = E_{\text{cell}}^{\circ} - \frac{0.0591}{2} \log K$$

$$\Rightarrow 1.1 = \frac{0.0591}{2} \log K$$

$$\Rightarrow K = \log^{-1} \left(\frac{2.2}{0.0591} \right)$$

$$\Rightarrow K = 1.679 \times 10^{37} \quad (K \rightarrow \text{unitless})$$

* $\log_{10}(1000) = 3$

(Logarithmic form)

(Anti-log)

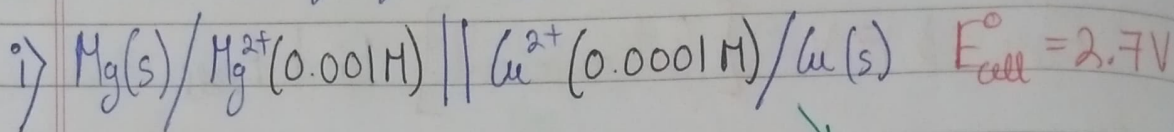
$10^3 = 1000$

(Exponential form)

$$\frac{[\text{Product}]}{[\text{Reactant}]} = \frac{[\text{M}]}{[\text{M}]} = M^0$$

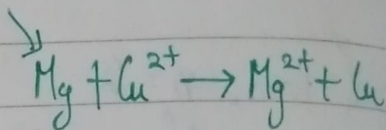
$$[M^0] = 1$$

Q3. Calculate E_{cell} for following cell reactions :-



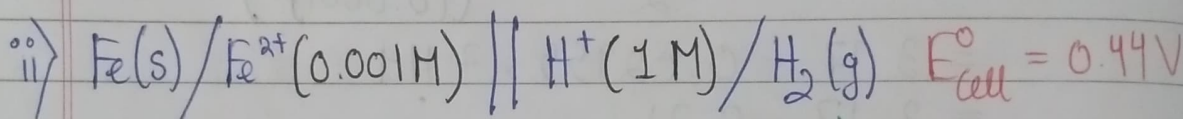
Solⁿ:- $E_{\text{cell}} = E_{\text{cell}}^{\circ} - \frac{0.0591}{2} \log \frac{[\text{Cu}^{2+}]}{[\text{Mg}^{2+}]}$

$$= 2.7 - 0.02955 \log \left(\frac{0.0001}{0.001} \right)$$



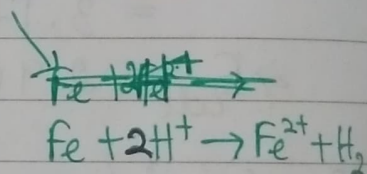
$$= 2.7 - 0.02955 \times (-1)$$

$$E_{\text{cell}} = 2.72955\text{V}$$



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

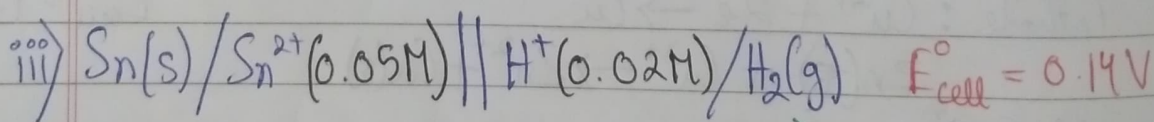
$$= 0.44 - 0.02955 \log \left(\frac{1 \times 1}{0.001} \right)$$



$$= 0.44 - 0.02955 \times 3$$

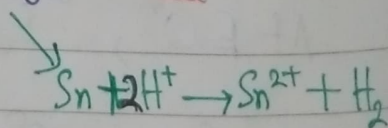
$$= 0.44 - 0.09$$

$$E_{\text{cell}} = 0.35\text{V}$$



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

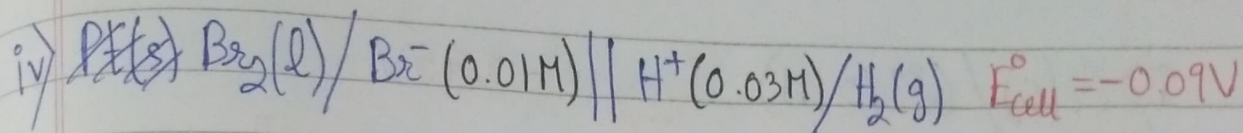
$$= 0.14 - 0.02955 \log \left(\frac{0.02 \times 0.02}{0.05} \right)$$



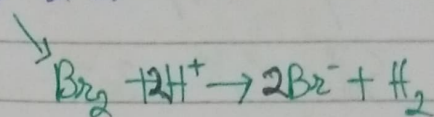
$$= 0.14 - 0.02 \times (-2.1)$$

$$= 0.14 + 0.063$$

$$E_{\text{cell}} = 0.203\text{V}$$



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



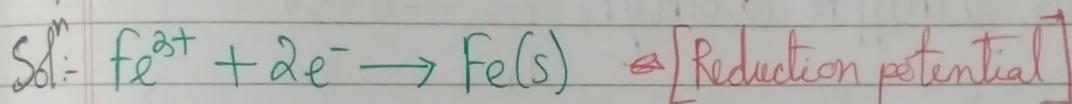
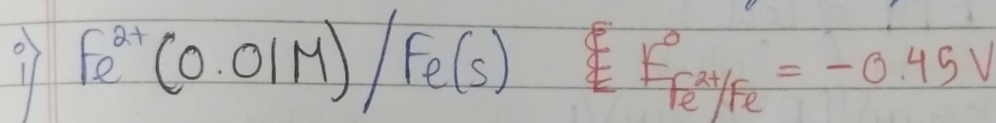
$= -0.09 - 0.03 \log \left(\frac{0.03 \times 0.03}{0.01 \times 0.01} \right)$

$= -0.09 - 0.03 \times 0.954$

$= -0.09 - 0.0029$

$E_{\text{cell}} = -0.0929V$

Q4. Calculate the electrode potential for the following:-



$\therefore E_{\text{Fe}^{2+}/\text{Fe}} = E_{\text{Fe}^{2+}/\text{Fe}}^{\circ} - \frac{0.0591}{2} \log \frac{[\text{Fe}]}{[\text{Fe}^{2+}]}$

$= -0.45 - \frac{0.0591}{2} \log \left(\frac{1}{0.01} \right)$

$= -0.45 - \frac{0.0591}{2} \times 2$

$\Rightarrow E_{\text{Fe}^{2+}/\text{Fe}} = -0.509V \quad [E_{\text{Fe}^{2+}/\text{Fe}} \rightarrow \text{Reduction potential}]$

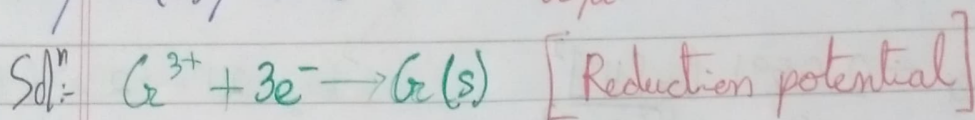
* For reduction potential, $-ve : -\frac{0.0591}{n} \log Q$

For oxidation potential, $+ve : +\frac{0.0591}{n} \log Q$

1/ Conc of Product/Reactant (solid/liquid/gas)

$[\text{Product}] / [\text{Reactant}]$ is taken as 1

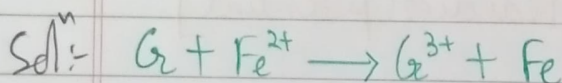
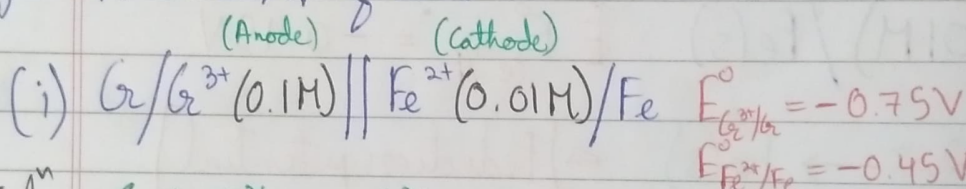
$$\text{Q.1)} \text{Cr}(s) / \text{Cr}^{3+}(0.1\text{M}) \quad E_{\text{Cr}^{3+}/\text{Cr}}^{\circ} = -0.75\text{V}$$



$$\begin{aligned} \therefore E_{\text{Cr}^{3+}/\text{Cr}} &= E_{\text{Cr}^{3+}/\text{Cr}}^{\circ} - \frac{0.0591}{3} \log \frac{[\text{Cr}]}{[\text{Cr}^{3+}]} \\ &= -0.75 - \frac{0.0591}{3} \log \left(\frac{1}{0.1} \right) \\ &= -0.75 - 0.0197 \times (1) \end{aligned}$$

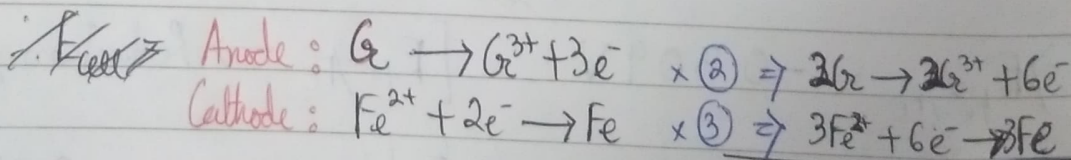
$$E_{\text{Cr}^{3+}/\text{Cr}} = -0.769\text{V}$$

* Qs. Find EMF of Cell :-



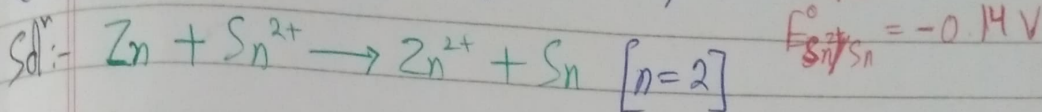
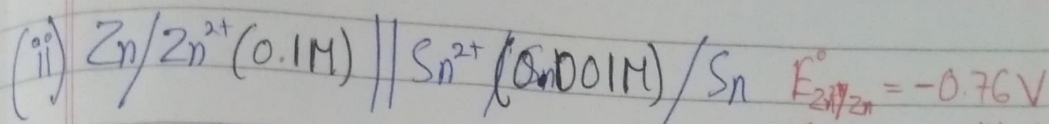
By default, we always take Reduction Potential

$$\begin{aligned} \therefore E_{\text{cell}} &= E_{\text{Cathode}}^{\circ} - E_{\text{Anode}}^{\circ} \quad (\text{or}) \quad E_{\text{Right}}^{\circ} - E_{\text{Left}}^{\circ} \\ &= -0.45 - (-0.75) \quad (E_{\text{Fe}^{2+}/\text{Fe}}^{\circ}) \quad (E_{\text{Cr}^{3+}/\text{Cr}}^{\circ}) \\ \Rightarrow E_{\text{cell}} &= 0.3\text{V} \end{aligned}$$



$$\begin{aligned} \therefore E_{\text{cell}} &= E_{\text{cell}}^{\circ} - \frac{0.0591}{n} \log \frac{[\text{Cr}^{3+}]^2}{[\text{Fe}^{2+}]^3} \quad \therefore n=6 \quad 2\text{Cr} + 3\text{Fe}^{2+} \rightarrow 2\text{Cr}^{3+} + 3\text{Fe} \\ &= 0.3 - \frac{0.0591}{6} \log \left(\frac{0.1 \times 0.1}{0.01 \times 0.01 \times 0.01} \right) \\ &= 0.3 - 0.0394 \\ &= 0.3 - 0.04 \end{aligned}$$

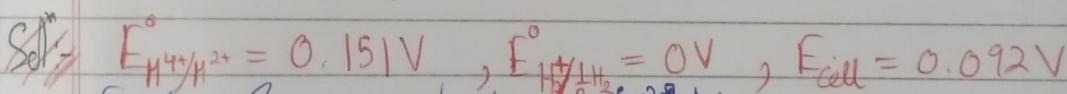
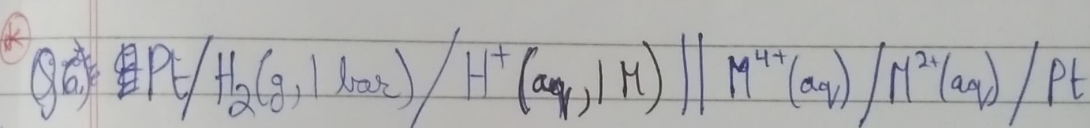
$$\Rightarrow E_{\text{cell}} = 0.26$$



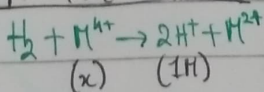
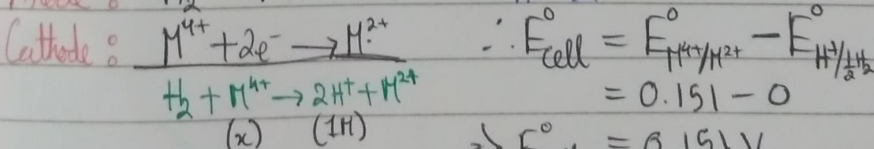
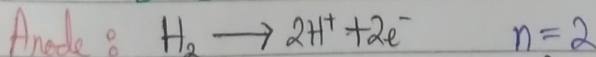
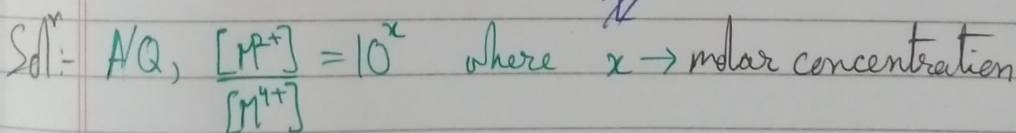
$$\begin{aligned} \therefore E_{\text{cell}}^{\circ} &= E_{\text{Sn}^{2+}/\text{Sn}}^{\circ} - E_{\text{Zn}^{2+}/\text{Zn}}^{\circ} \\ &= -0.14 - (-0.76) \\ &= 0.62\text{V} \end{aligned}$$

$$\begin{aligned} E_{\text{cell}} &= E_{\text{cell}}^{\circ} - \frac{0.0591}{n} \log \frac{[\text{Zn}^{2+}]}{[\text{Sn}^{2+}]} \\ &= 0.62 - \frac{0.06}{2} \log \left(\frac{0.1}{0.001} \right) \\ &= 0.62 - 0.03 \times 2 \end{aligned}$$

$$E_{\text{cell}} = \cancel{0.02} 0.56\text{V}$$



Find molar concentration of ~~M^{2+}~~ M



$$= 0.151 - 0$$

$$\Rightarrow E_{\text{cell}}^{\circ} = 0.151\text{V}$$

$$\therefore E_{\text{cell}} = E_{\text{cell}}^{\circ} - \frac{0.0591}{2} \log \left(\frac{[\text{H}^+]^2 [\text{M}^{2+}]}{[\text{H}_2] [\text{M}^{4+}]} \right)$$

$$\Rightarrow 0.092 = 0.151 - \frac{0.06}{2} \log \left(\frac{(1)^2 \times 10^x}{1} \right)$$

$$\Rightarrow 0.059 = +0.03 \cdot x$$

$$\Rightarrow x = \frac{0.059}{0.03} = \frac{0.06}{0.03} \Rightarrow \boxed{x = 2\text{M}}$$