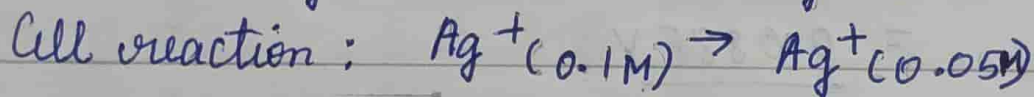
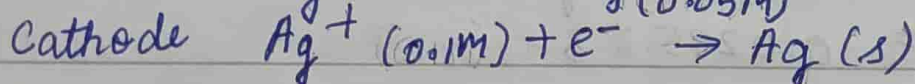
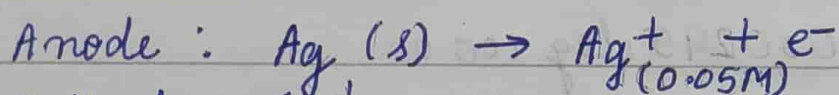


→ Problems

1. A concentration cell was constructed by immersing two silver electrodes in 0.05 M and 0.1 M AgNO_3 solution. Write the cell reactions and calculate the EMF of the concentration cell at 298 K.

$$E_{\text{cell}} = \frac{0.0591}{n} \log \left[\frac{C_2}{C_1} \right], \quad C_2 > C_1$$

Cell reaction:

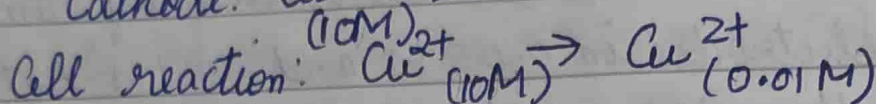
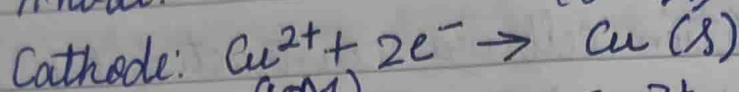
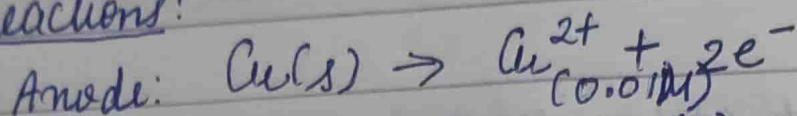


$$E_{\text{cell}} = \frac{0.0591}{1} \log \left[\frac{0.1}{0.05} \right]$$

$$= \underline{\underline{0.0177 \text{ V}}}$$

2. A concentration cell was constructed by immersing two copper electrodes in 0.01 M and 10 M CuSO_4 solution. Write the cell reactions, cell representation and calculate the EMF of the concentration cell at 298 K.

Cell reactions:



EMF

$$E_{\text{cell}} = \frac{0.0591}{n} \log \left[\frac{C_2}{C_1} \right]$$

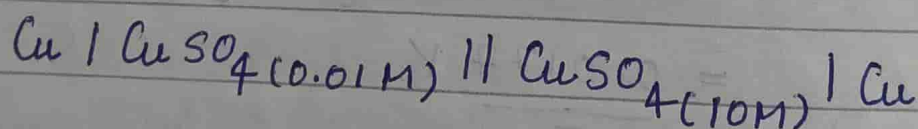
$$= \frac{0.0591}{2} \log \left[\frac{10}{0.01} \right]$$

$$= 0.0295 \log 1000$$

$$= 0.0295 \times 3$$

$$= \underline{0.0885 \text{ V}}$$

Cell representation:



3. The spontaneous galvanic cell $\text{Sn} \mid \text{SnSO}_4(0.024M) \parallel \text{SnSO}_4(0.064M) \mid \text{Sn}$ develops an emf of 0.0126 V at 25°C . Calculate the value of T_{in} .

Given: - $\text{Sn} \mid \text{SnSO}_4(0.024M) \parallel \text{SnSO}_4(0.064M) \mid \text{Sn}$

$$E_{\text{cell}} = \frac{0.0591}{n} \log \left[\frac{C_2}{C_1} \right]$$

$$0.0126 = \frac{0.0591}{n} \log \left[\frac{0.064}{0.024} \right]$$

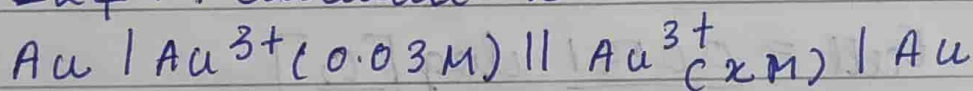
$$n = \frac{0.0591}{0.0126} \log [2.6666]$$

$$= 4.6904 \times 0.4259$$

$$= 1.9976 \approx \underline{\underline{2}}$$

$$\therefore \underline{\underline{n \text{ (Valency)} = 2}}$$

4. The emf of concentration cell at 25°C is ~~At~~ 0.024 V . Calculate x .



$$E_{\text{cell}} = \frac{0.0591}{n} \log \frac{[C_2]}{[C_1]}$$

$$0.024 = \frac{0.0591}{3} \log \frac{[x\text{M}]}{[0.03\text{M}]}$$

$$0.024 = 0.0197 \log \frac{[x\text{M}]}{[0.03\text{M}]}$$

$$1.2182 = \log \frac{[x\text{M}]}{[0.03\text{M}]}$$

$$\text{antilog}(1.2182) = \frac{x\text{M}}{0.03\text{M}}$$

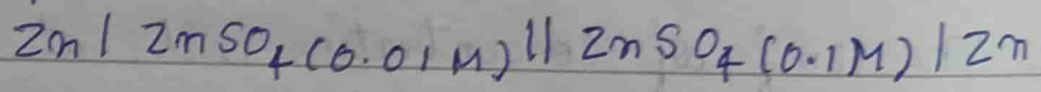
$\hookrightarrow 10^{\square}$

$$16.527 = \left[\frac{x}{0.03} \right]^{1.2182}$$

$$x = \underline{0.4958 \text{ M}}$$

5. write the cell representation and calculate the EMF of the concentration cell at 25°C consisting of two Zn electrodes immersed in solution of 0.1M and 0.01M ZnSO_4 solution connected internally by salt bridge.

Cell representation:



$$E_{\text{cell}} = \frac{0.0591}{n} \log \left[\frac{C_2}{C_1} \right]$$

$$= \frac{0.0591}{2} \log \left[\frac{0.1}{0.01} \right]$$

$$= 0.0295 \times 1$$

$$= \underline{0.0295 \text{ V}}$$

6. Calculate the EMF of the given concentration cell at 298K
 $\text{Ag} | \text{AgNO}_3 (0.018 \text{ M}) || \text{AgNO}_3 (1.2 \text{ M}) | \text{Ag}$

Given: $\text{Ag} | \text{AgNO}_3 (0.018 \text{ M}) || \text{AgNO}_3 (1.2 \text{ M}) | \text{Ag}$

$$E_{\text{cell}} = \frac{0.0591}{n} \log \left[\frac{C_2}{C_1} \right]$$

$$E_{\text{cell}} = \frac{0.0591}{1} \log \frac{[1.2]}{[0.018]}$$

$$= 0.0591 \log [66.66]$$

$$= 0.0591 \times 1.8238$$

$$= \underline{\underline{0.1077 \text{ V}}}$$

7. A cell is obtained by combining two cadmium electrodes immersed in cadmium sulphate solution of 0.1M and 0.5M at 298 K. Give the cell representation, cell reactions and calculate EMF of the cell.

Cell Representation: $\text{Cd} | \text{CdSO}_4 (0.1 \text{ M}) || \text{CdSO}_4 (0.5 \text{ M}) | \text{Cd}$

Cell Reaction: Anode : $\text{Cd(s)} \rightarrow \text{Cd}_{(0.1 \text{ M})}^{2+} + 2\text{e}^-$

Cathode : $\text{Cd}_{(0.5 \text{ M})}^{2+} + 2\text{e}^- \rightarrow \text{Cd(s)}$

Net Reaction: $\text{Cd}^{2+}(0.5 \text{ M}) \rightarrow \text{Cd}^{2+}(0.1 \text{ M})$

$$E_{\text{cell}} = \frac{0.0591}{n} \log \left[\frac{C_2}{C_1} \right]$$

$$= \frac{0.0591}{2} \log \frac{[0.5]}{[0.1]}$$

$$= 0.0295 \times \log (5)$$

$$= 0.0295 \times 0.6989$$

$$= \underline{\underline{0.0206 \text{ V}}}$$

Eg: Suppose there are 50 polymer molecules of molecular weight 10^2 , 200 polymer molecules of molecular weight 10^3 , and then 100 molecules of molecular weight 10^4 . Then \bar{M}_n and \bar{M}_w ?

Given $n_1 = 50$ $M_1 = 10^2$

$n_2 = 200$ $M_2 = 10^3$

$n_3 = 100$ $M_3 = 10^4$

$$\bar{M}_n = \frac{\sum n_i M_i}{\sum n_i} = \frac{\overset{5000}{(50 \times 10^2)} + \overset{2,00,000}{(200 \times 10^3)} + \overset{10,00,000}{(100 \times 10^4)}}{(50 + 200 + 100)}$$

$$= \frac{34435}{350} = 3442.8 \text{ g/mol}$$

$$\bar{M}_w = \frac{\sum n_i M_i^2}{\sum n_i M_i}$$

$$= \frac{50 \times (10^2)^2 + 200 \times (10^3)^2 + 100 \times (10^4)^2}{50 \times 10^2 + 200 \times 10^3 + 100 \times 10^4}$$

$$= \frac{50000 + 20000000 + 10^{18}}{5000 + 2,00,000 + 10,00,000}$$

$$= \underline{\underline{8465.14 \text{ g/mol}}}$$

2) A polymer sample contains 5 molecules having a molecular weight of 2000, 4 molecules having molecular weight of 3000 and 3 molecules of 4000 wt. Calculate \bar{M}_n and \bar{M}_w ?

Given: $n_1 = 5$ $M_1 = 2000$

$n_2 = 4$ $M_2 = 3000$

$n_3 = 3$ $M_3 = 4000$

$$\bar{M}_n = \frac{\sum n_i M_i}{\sum n_i} = \frac{5 \times 2000 + 4 \times 3000 + 3 \times 4000}{5 + 4 + 3}$$

$$= \underline{2833.33 \text{ g/mol}}$$

$$\bar{M}_w = \frac{\sum n_i M_i^2}{\sum n_i M_i} = \frac{5 \times (2000)^2 + 4 \times (3000)^2 + 3 \times (4000)^2}{5 \times 2000 + 4 \times 3000 + 3 \times 4000}$$

$$= \frac{5 \times 4000 + 4 \times 8000 + 3 \times 16000}{5 \times 2000 + 4 \times 3000 + 3 \times 4000}$$

$$= \underline{3058.82}$$

2. A polymer has the following composition 100 molecules of molecular mass 1000 g/mol, 200 molecules of molecular mass 2000 g/mol and 500 molecules of molecular mass 5000 g/mol. Calculate the number and weight average molecular weight.

$$n_1 = 100, n_2 = 200, n_3 = 500$$

$$M_1 = 1000 \text{ g/mol}, M_2 = 2000 \text{ g/mol}, M_3 = 5000 \text{ g/mol}$$

$$\bar{M}_n = \frac{\sum n_i M_i}{\sum n_i} = \frac{1000 + 2000 + 5000}{100 + 200 + 500} = \frac{8000}{800}$$

$$\bar{M}_n = 10 \text{ g/mol}$$

$$\bar{M}_w = \frac{\sum n_i M_i^2}{\sum n_i M_i} = \frac{100 \times 1000 + 200 \times 2000 + 500 \times 5000}{100 + 200 + 500} = \frac{3750}{1} \text{ g/mol}$$

$$\bar{M}_w = \frac{\sum n_i M_i^2}{\sum n_i M_i} = \frac{100 \times (1000)^2 + 200 \times (2000)^2 + 500 \times (5000)^2}{100 \times 1000 + 200 \times 2000 + 500 \times 5000}$$

$$\bar{M}_w = \frac{10^8 + 8 \times 10^8 + 125 \times 10^8}{10^5 + 4 \times 10^5 + 25 \times 10^5} = \frac{215 \times 10^8}{30 \times 10^5} = 7166.66 \text{ g/mol}$$

3. Calculate the number average and weight average molecular mass of a polymer sample in which 20% molecules have a molecular mass 20,000, 40% molecules have 30,000 and rest have 60,000.

$$\begin{aligned}\bar{M}_n &= \frac{\sum n_i M_i}{\sum n_i} = \frac{30 \times 20000 + 40 \times 30000 + 30 \times 60000}{30 + 40 + 30} \\ &= \underline{36000 \text{ g/mol}}\end{aligned}$$

$$\begin{aligned}\bar{M}_w &= \frac{\sum n_i (M_i)^2}{\sum n_i M_i} = \frac{30 \times (20000)^2 + 40 \times (30000)^2 + 30 \times (60000)^2}{30 \times 20000 + 40 \times 30000 + 30 \times 60000} \\ &= \frac{12 \times 10^9 + 36 \times 10^9 + 108 \times 10^9}{6 \times 10^5 + 12 \times 10^5 + 18 \times 10^5} \\ &= \underline{43333.33 \text{ g/mol}}\end{aligned}$$