Important Questions numerical :

M-3:

Q2.

Cell representation: $Ag(s) | AgNO_3 || AgNO_3 | Ag(s)$
$C_1 = (0.05\,M)$ $(1M) = C_2$

At anode, $Ag \rightarrow Ag^+ + 1e^-$

At cathode, $Ag^+ + 1e^- \rightarrow Ag$

Net cell reaction, $Ag + Ag^+ \rightarrow Ag^+ + Ag$

$E_{cell} = \frac{0.0591}{n} \log\left[\frac{1}{0.05}\right]$ $(\because n=1)$

$= 0.0591 \cdot \log 20$

$= 0.0591 \times 1.301$

$E_{cell} = 0.0769V$

Q3. Cell representation;

$Cd | CdSO_4(0.0093M) || CdSO_4(XM) | Cd$
C_1 C_2

→ cell reaction,

At Anode,

$Cd \rightarrow Cd^{2+} + 2e$

At cathode,

$Cd^{2+} + 2e^- \rightarrow Cd$

Net reaction, $Cd + Cd^{2+} \rightarrow Cd^{2+} + Cd$

$\therefore n=2$ & $E_{cell} = 0.03V$ (given)

$\Rightarrow E_{cell} = \frac{0.0591}{2} \cdot \log\left[\frac{x}{0.0093}\right]$ $\left(\because E_{cell} = \frac{0.0591}{n} \log\frac{[C_2]}{[C_1]}\right)$

$$0.03 = \frac{0.0591}{2} \log\left[\frac{x}{0.0093}\right]$$

$$\log\left[\frac{x}{0.0093}\right] = \frac{0.03 \times 2}{0.0591}$$

$$\log\left[\frac{x}{0.0093}\right] = 1.0152$$

$$\frac{x}{0.0093} = \text{anti}\log[1.0152]$$

$$\frac{x}{0.0093} = 10.35$$

$$x = 10.35 \times 0.0093$$

$$x = 0.096255$$

Q4. → Cell representation,

$$\underset{C_1}{Cu \mid CuSO_4 (XM)} \parallel \underset{C_2}{CuSO_4 (1.0M) \mid Cu}$$

→ $E_{cell} = 0.0295V$

→ Cell reaction,

At anode,

$$Cu \rightarrow Cu^{2+} + 2e$$

At cathode,

$$Cu^{2+} + 2e \rightarrow Cu \quad , \quad n = 2$$

$$\rightarrow E_{cell} = \frac{0.0591}{2} \log\left[\frac{1}{X}\right] \qquad \left(\because E_{cell} = \frac{0.0591}{n} \log\left[\frac{C_2}{C_1}\right]\right)$$

$$0.0295 = \frac{0.0591}{2} \log\left(\frac{1}{x}\right)$$

$$\log \frac{1}{x} = \frac{0.0295 \times 2}{0.0591}$$

$$\log \frac{1}{x} = 0.9983$$

$$\frac{1}{x} = \text{antilog}[0.9983]$$

$$\Rightarrow 1/x = 9.961$$

$$x = 1/9.961$$

$$x = 0.1004$$

Q9. $CPR = \frac{K.W}{\rho.A.T}$

where, K = CPR constant
W = weight of metal lost
ρ = density of the metal
A = Surface area of corrosion
T = Time taken at which Corrosion take place.

	Given	In mpy	In mmpy
K		534	87.6
W	485g	485×10^3	485×10^3
ρ	$7.9 g/cm^3$	7.9	7.9
A	100 $inch^2$	100 $inch^2$	$(6.45\times100) cm^2$
T	1y	365×24	365×24

~~inches~~

$1kg = 10^6 mg$
$1g = 10^3 mg$

$1 inch^2 = 6.45 cm^2$
$1 cm^2 = 0.155 inch^2$

$$CPR (\text{in mpy}) = \frac{K.W}{\rho.A.T}$$
$$= \frac{534\times485\times10^3}{7.9\times100\times365\times24}$$
$$= 37.4 \text{ in mpy}$$

$$CPR (\text{in mmpy}) = \frac{K.W}{\rho.A.T}$$
$$= \frac{87.6\times485\times10^3}{7.9\times6.45\times100\times365\times24}$$
$$= 0.9518 \text{ in mmpy.}$$

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Q10)

$$CPR = \frac{KW}{\rho . A . T}$$

	Given	In mpy
K		534
W	1.2 Kg	1.2×10^6
ρ	7.87 g/cm³	7.87
A	20 inch²	20 inch²
T	?	?
CPR	400 mpy	400 mpy

$$\Rightarrow 400 = \frac{534 \times 1.2 \times 10^6}{7.87 \times 20 \times T}$$

$$T = \frac{534 \times 1.2 \times 10^6}{7.87 \times 20 \times 400}$$

$T = 10177.8907$ hours

$T = 1.162$ years

Q11)

In mpy, $CPR = \frac{K . W}{\rho . A . T}$

	Given	CPR in mpy	CPR in mmpy
K		534	87.6
W	525g	525×10^3	$525 10^3$
ρ	7.9 g/cm³	7.9	7.9
A	120 inch²	120 inch²	120×6.45
T	1 year	365×24	365×24

$$= \frac{534 \times 525 \times 10^3}{7.9 \times 120 \times 365 \times 24}$$

$= 33.76$ mpy (approx)

$$CPR \text{ (in mmpy)} = \frac{87.6 \times 525 \times 10^3}{7.9 \times 120 \times 6.45 \times 365 \times 24}$$

$= 0.8586$ mmpy

Q12.)

	Given	In mpy
K		534
W	2.5 kg	2.5×10^6
ρ	7.87 g/cm³	7.87
A	35 inch²	35 inch²
T	?	?
CPR	500 mpy	500

In mpy, $CPR = \frac{534 \times 2.5 \times 10^6}{7.87 \times 35 \times T}$

$$500 = \frac{534 \times 2.5 \times 10^6}{7.87 \times 35 \times T}$$

$$T = \frac{534 \times 2.5 \times 10^6}{7.87 \times 35 \times 500}$$

$T = 9693.23$ hours

$T = 1.1065$ year

Module 4:

Q1. Given,

$N_1 = 10$ $M_1 = 100$

$N_2 = 20$ $M_2 = 200$

$N_3 = 30$ $M_3 = 300$

$N_4 = 40$ $M_4 = 400$

$$\overline{M}_n = \frac{\Sigma N_k M_k}{N_k}$$

$$= \frac{N_1 M_1 + N_2 M_2 + N_3 M_3 + N_4 M_4}{N_1 + N_2 + N_3 + N_4}$$

$$= \frac{(10 \times 100) + (20 \times 200) + (30 \times 300) + (40 \times 400)}{10 + 20 + 30 + 40}$$

$$= \frac{1000 + 4000 + 9000 + 16000}{100}$$

$$= \frac{30000}{100}$$

$$= 300$$

$$\overline{M}_W = \frac{\Sigma N_k (M_k)^2}{N_k M_k}$$

$$= \frac{(10 \times 100^2) + (20 \times 200^2) + (30 \times 300^2) + (40 \times 400^2)}{30000}$$

$$= \frac{10000000}{30000}$$

$$= \frac{1000}{3}$$

$$= 333.33$$

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Q2.) Given,

$N_1 = 100$ $\quad M_1 = 1000$

$N_2 = 200$ $\quad M_2 = 2000$

$N_3 = 300$ $\quad M_3 = 3000$

$N_4 = 400$ $\quad M_4 = 4000$

$$\overline{M_n} = \frac{\Sigma N_K M_K}{N_K}$$

$$= \frac{(100\times1000)+(200\times2000)+(300\times3000)+(400\times4000)}{100+200+300+400}$$

$$= \frac{100000+400000+900000+1600000}{1000}$$

$$= \frac{3000000}{1000}$$

$$= 3000$$

$$\overline{M_w} = \frac{\Sigma N_K (M_K)^2}{N_K M_K}$$

$$= \frac{(100\times1000^2)+(200\times2000^2)+(300\times3000^2)+(400\times4000^2)}{3{,}000{,}000}$$

$$= 3333.3\bar{3}$$

$$PDI = \frac{\overline{M_w}}{\overline{M_N}} = \frac{3333.3\bar{3}}{3000} = 1.11$$

Q3. Given,

$N_1 = 100$ $M_1 = 15000$

$N_2 = 200$ $M_2 = 20000$

$N_3 = 300$ $M_3 = 25000$

$$\bar{M}_n = \frac{\Sigma N_K M_K}{N_K}$$

$$= \frac{(100 \times 15000) + (200 \times 20000) + (300 \times 25000)}{100 + 200 + 300}$$

$$= \frac{1500000 + 4000000 + 7500000}{600}$$

$$= \frac{13000000}{600}$$

$$= 21666.667$$

$$\bar{M}_w = \frac{\Sigma N_K M_K^2}{\Sigma N_K M_K}$$

$$= \frac{(100 \times 15000^2) + (200 \times 20000^2) + (300 \times 25000^2)}{13000000}$$

$$= \frac{2.9 \times 10^{11}}{13 \times 10^6}$$

$$= 22307.69$$

$$PDI = \frac{\bar{M}_w}{\bar{M}_N} = \frac{22307.69}{21666.667} \approx 1.0295 \simeq 1.03$$