Table 1: EMF measured for various concentrations of M/M^{n+} system

Electrode / Electrolyte	Electrolyte conc. (N)	E_{cell} (V)	$E_{M/M+} = E_{cell} + E_{calomel}$	$E^{o}_{M/M+}$ (From Eq 1)	Average $E^{o}_{M/M+}$
Zn/Zn^{2+}	0.01	-0.998	-0.754	-0.691	-0.725
	0.05	-1.023	-0.779	-0.733	
	0.1	-1.035	-0.791	-0.752	
ω/ω^{2+}	0.01	0.275	0.519	0.582	0.702
	0.05	0.400	0.644	0.690	
	0.1	0.550	0.794	0.833	

Equation 1

$$E^{o}_{M/M+} = E_{M/M+} - \frac{0.0595}{n} \log(\gamma_c \times C)$$

Table 2: Individual activity coefficients of ω^{2+} and Zn^{2+} in water at 25°C

Metal ion system (ω^{2+}/Zn^{2+})	0.001	0.002	0.005	0.01	0.02	0.05	0.1	0.2
Activity coefficient (γ_c)	0.905	0.870	0.809	0.749	0.675	0.570	0.485	0.405

Table 3(1): EMF of Daniel cell observed from two different concentrations of zinc and copper solutions (At 30°C / 303K)

$[\omega^{2+}]$	$[Zn^{2+}]$	E_{cell} (calculated by Nernst Equation)	E_{cell} (Experimental)	% Error	Free-energy change (ΔG) or W_{max} (KJ/mol)
0.01 M	0.05 M	1.08 V	0.99 V	8.3 %	-191.1
0.05 M	0.01 M	1.121 V	1.013 V	9.6 %	-195.5
0.1 M	0.1 M	1.1 V	1.068 V	2.9 %	-206.1

$[Cu^{2+}]$	$[Zn^{2+}]$	E_{cell} (calculated by Nernst Equation)	E_{cell} (Experimental)	% Error	Free-energy change (ΔG) or w_{max} (kJ/mol)
0.01 M	0.05 M	1.078 V	1.020 V	5.3 %	-196.8
0.05 M	0.01 M	1.122 V	1.036 V	7.7 %	-199.9
0.1 M	0.1 M	1.1 V	1.082 V	1.6 %	-208.8

Table 3(2): At 50°C / 323 K

Nernst Equation

$$E = E^{\circ} - \frac{RT}{nF} \ln \frac{[Zn^{2+}]}{[Cu^{2+}]}$$

Calculation of ΔG

$$\Delta G = -nFE_{cell}$$

Table 4: Final Results (At 40°C / 313 K)

$[Cu^{2+}]$	$[Zn^{2+}]$	ΔG, kJ/mol	ΔH, kJ/mol	ΔS, kJ/K/mol
0.01 M	0.05 M	-193.9	-104.7	0.28
0.05 M	0.01 M	-197.7	-128.8	0.22
0.1 M	0.1 M	-207.5	-165.2	0.14

Gibbs - Helmholtz Equation

$$\Delta H = \Delta G - T\left[\left(\partial(\Delta G)/\partial T\right)\right]_P$$

$$\Delta G = \Delta H - T\Delta S$$