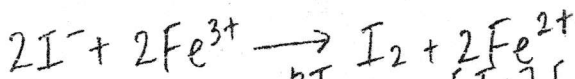
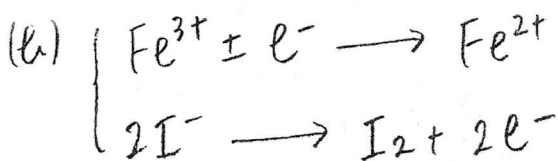


ネルンストの式より

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

$$\begin{aligned} \Delta E^\circ &= \Delta E^\circ_{\text{Cd}} - \Delta E^\circ_{\text{Zn}} \\ &= -0.403 - (-0.763) \\ &= 0.36 \end{aligned}$$

$$\begin{aligned} \Delta E &= 0.36 - \frac{8.314 \times 298}{2 \times 96485} \ln \frac{10^{-4}}{0.1} \\ &= 0.36 + 0.01283 \times 3 \times 2.303 \\ &= 0.36 + 0.4147 \\ &= 0.77747 \\ &= 0.777 \text{ (V)} \end{aligned}$$



$$\Delta E = \Delta E^\circ - \frac{RT}{nF} \ln \frac{[\text{I}_2][\text{Fe}^{2+}]^2}{[\text{I}^-]^2[\text{Fe}^{3+}]^2}$$

$$\Delta E^\circ = 0.536 - 0.356 = 0.2$$

$$\begin{aligned} \Delta E &= 0.2 - \frac{8.314 \times 298}{2 \times 96485} \times \ln \times 10^{-4} \\ &= 0.2788 \text{ (V)} \end{aligned}$$

5. 自由度が5つの一般的な

$$E = N\varepsilon = N \cdot \frac{5}{2} kT = (nL) \cdot \frac{5}{2} \cdot \left(\frac{R}{L}\right) \cdot T$$

$$= \frac{5}{2} nRT$$

今 $n=1$ より

$$E = \frac{5}{2} nRT$$

$$\text{今 } n = \frac{5}{2}$$

$$E = \frac{5}{2} RT = \frac{5}{2} \times 8.314 \times 300$$

$$\text{すなわち } \approx 6.24 \text{ kJ}$$

$$C_p = \frac{dQ}{dT} = \frac{6235.5}{300} = 20.785 \approx 20.8 \text{ (J/K)}$$

6. (1) U を T と V の関数と考えると U の全微分は

$$dU = \left(\frac{\partial U}{\partial T}\right)_V dT + \left(\frac{\partial U}{\partial V}\right)_T dV \quad \dots \textcircled{1}$$

V は T と P の関数であるので

$$dV = \left(\frac{\partial V}{\partial T}\right)_P dT + \left(\frac{\partial V}{\partial P}\right)_T dP \quad \dots \textcircled{2}$$

② を ① に代入

$$dU = \left[\left(\frac{\partial U}{\partial T}\right)_V + \left(\frac{\partial U}{\partial V}\right)_T \left(\frac{\partial V}{\partial T}\right)_P\right] dT + \left(\frac{\partial U}{\partial V}\right)_T \left(\frac{\partial V}{\partial P}\right)_T dP \quad \dots \textcircled{3}$$

一方 U は T と P の関数と考えるときも成り立つ

$$dU = \left(\frac{\partial U}{\partial T}\right)_P dT + \left(\frac{\partial U}{\partial P}\right)_T dP \quad \dots \textcircled{4}$$

dT と dP は独立より

$$\left(\frac{\partial U}{\partial T}\right)_P = \left(\frac{\partial U}{\partial T}\right)_V + \left(\frac{\partial U}{\partial V}\right)_T \left(\frac{\partial V}{\partial T}\right)_P \quad \dots \textcircled{5}$$

次に $H = U + PV$ の両辺を P を一定として T で微分すると

$$\left(\frac{\partial H}{\partial T}\right)_P = \left(\frac{\partial U}{\partial T}\right)_P + P \left(\frac{\partial V}{\partial T}\right)_P \quad \dots \textcircled{6}$$

⑥ に ⑤ を代入すると

$$\left(\frac{\partial H}{\partial T}\right)_P = \left(\frac{\partial U}{\partial T}\right)_V + \left[P + \left(\frac{\partial U}{\partial V}\right)_T\right] \left(\frac{\partial V}{\partial T}\right)_P$$

$$\left(\frac{\partial H}{\partial T}\right)_P = C_p, \quad \left(\frac{\partial U}{\partial T}\right)_V = C_v \text{ より}$$

$$C_p - C_v = \left[P + \left(\frac{\partial U}{\partial V}\right)_T\right] \left(\frac{\partial V}{\partial T}\right)_P$$