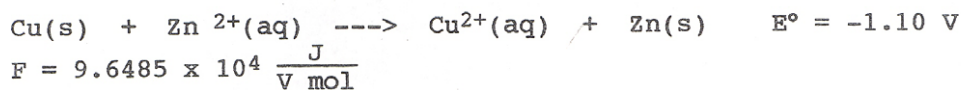


G. Problems:

① Calculate the ΔG° for the following redox reaction:



$$\begin{aligned} \Delta G_{\text{rxn}}^\circ &= -nFE^\circ \\ &= -(2.00 \text{ mol } e^-) \times \left(\frac{9.65 \times 10^4 \text{ J}}{\text{V mol}} \right) \times (-1.10 \text{ V}) \\ &= +212 \text{ kJ} \end{aligned}$$

② Calculate the equilibrium constant, K_p , for the following reaction at 25.0°C if ΔG° is -32.9 kJ:

$$\text{N}_2(\text{g}) + 3 \text{H}_2(\text{g}) \rightleftharpoons 2 \text{NH}_3(\text{g})$$

$$\Delta G_{\text{rxn}}^\circ = -RT \ln K_p$$

$$(-32.9 \text{ kJ}) \left(\frac{10^3 \text{ J}}{\text{kJ}} \right) = - \left(8.3145 \frac{\text{J}}{\text{K mol}} \right) (298 \text{ K}) \ln K_p$$

$$K_p = 6 \times 10^5$$

3 Calculate ΔG° , for the following reaction at 25.0°C if K_p is 1.1×10^{-16} :

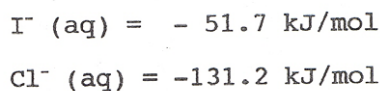
$$\text{NH}_4\text{Cl(s)} \rightleftharpoons \text{NH}_3(\text{g}) + \text{HCl(g)}$$

$$\Delta G_{\text{rxn}}^\circ = -RT \ln K_p$$

$$= - \left(8.3145 \frac{\text{J}}{\text{K mol}} \right) (298 \text{ K}) \ln(1.1 \times 10^{-16})$$

$$= 91 \text{ kJ}$$

④ Given the following ΔG° values:



Elements
 $\text{Cl}_2 = \phi$
 $\text{I}_2 = \phi$

Calculate E° for the following reaction: $\text{Cl}_2 + 2 \text{I}^-(\text{aq}) \rightleftharpoons 2 \text{Cl}^-(\text{aq}) + \text{I}_2$

$$\begin{aligned} \Delta G_{\text{rxn}} &= \sum m G_{\text{Prod}}^\circ - \sum n G_{\text{Reactants}}^\circ \\ &= [2(-131.2 \frac{\text{kJ}}{\text{mol}}) + \phi] - [\phi + 2(-51.7 \frac{\text{kJ}}{\text{mol}})] \\ &= -159.4 \frac{\text{kJ}}{\text{mol}} \end{aligned}$$

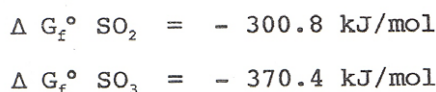
for an element

$$\Delta G_{\text{rxn}}^\circ = nFE^\circ$$

$$\left(\frac{10^3 \text{ J}}{1 \text{ kJ}} \right) \times (-159.4 \frac{\text{kJ}}{\text{mol}}) = -(2.00 \text{ mol } e^-) \left(\frac{9.65 \times 10^4 \text{ J}}{\text{V mol}} \right) E^\circ$$

$$E^\circ = 0.826 \text{ V}$$

5 Calculate K for the following reaction: $2 \text{SO}_2 + \text{O}_2 \rightleftharpoons 2 \text{SO}_3$ at 25.0°C



$$\begin{aligned} \Delta G_{\text{rxn}} &= 2(-370.4 \frac{\text{kJ}}{\text{mol}}) - (2(-300.8 \frac{\text{kJ}}{\text{mol}}) + \phi) \\ &= -139.2 \frac{\text{kJ}}{\text{mol}} \end{aligned}$$

$$\Delta G_{\text{rxn}} = -RT \ln K_p$$

$$-139.2 \frac{\text{kJ}}{\text{mol}} = - \left(8.3145 \frac{\text{J}}{\text{K mol}} \right) (298.15 \text{ K}) \ln K_p$$

$$K_p = 1.06$$