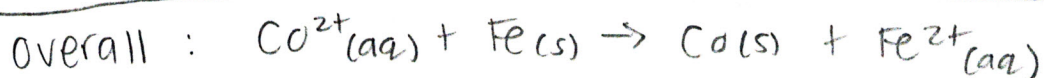
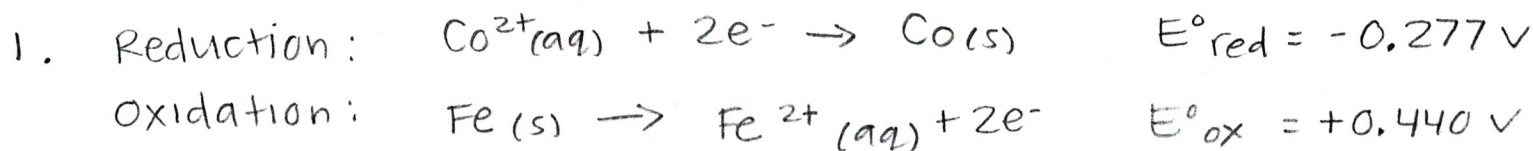
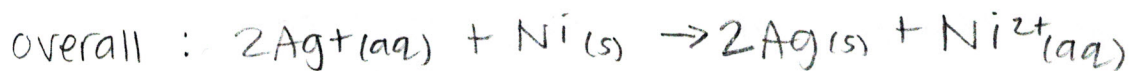
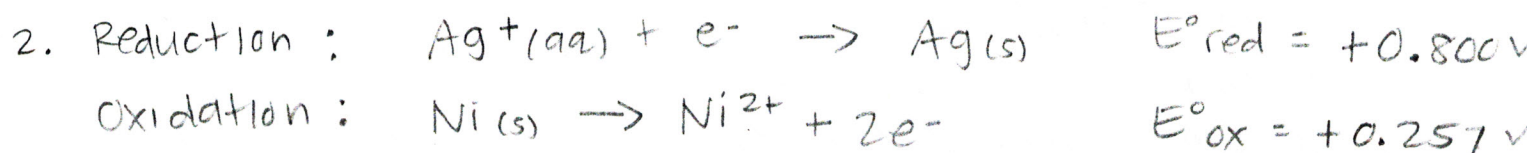


# Electro Homework

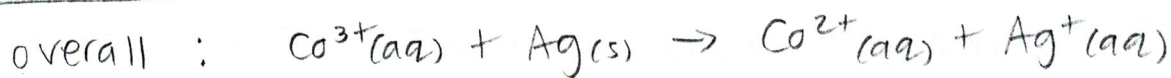
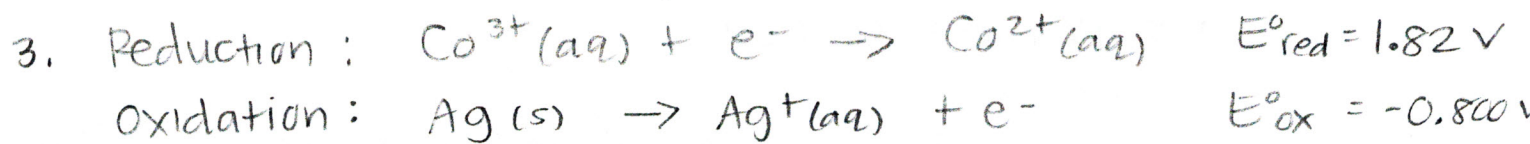
## Part A



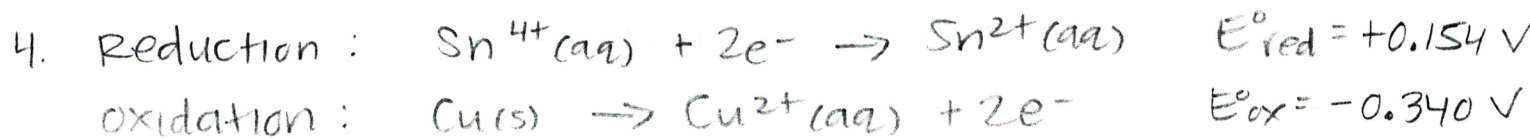
$$E^\circ_{\text{cell}} = -0.277 \text{ V} + 0.440 \text{ V} = \boxed{0.163 \text{ V}}$$



$$E^\circ_{\text{cell}} = 0.800 \text{ V} + 0.257 \text{ V} = \boxed{1.057 \text{ V}}$$



$$E^\circ_{\text{cell}} = 1.82 \text{ V} - 0.800 \text{ V} = \boxed{1.02 \text{ V}}$$

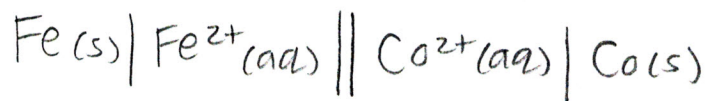
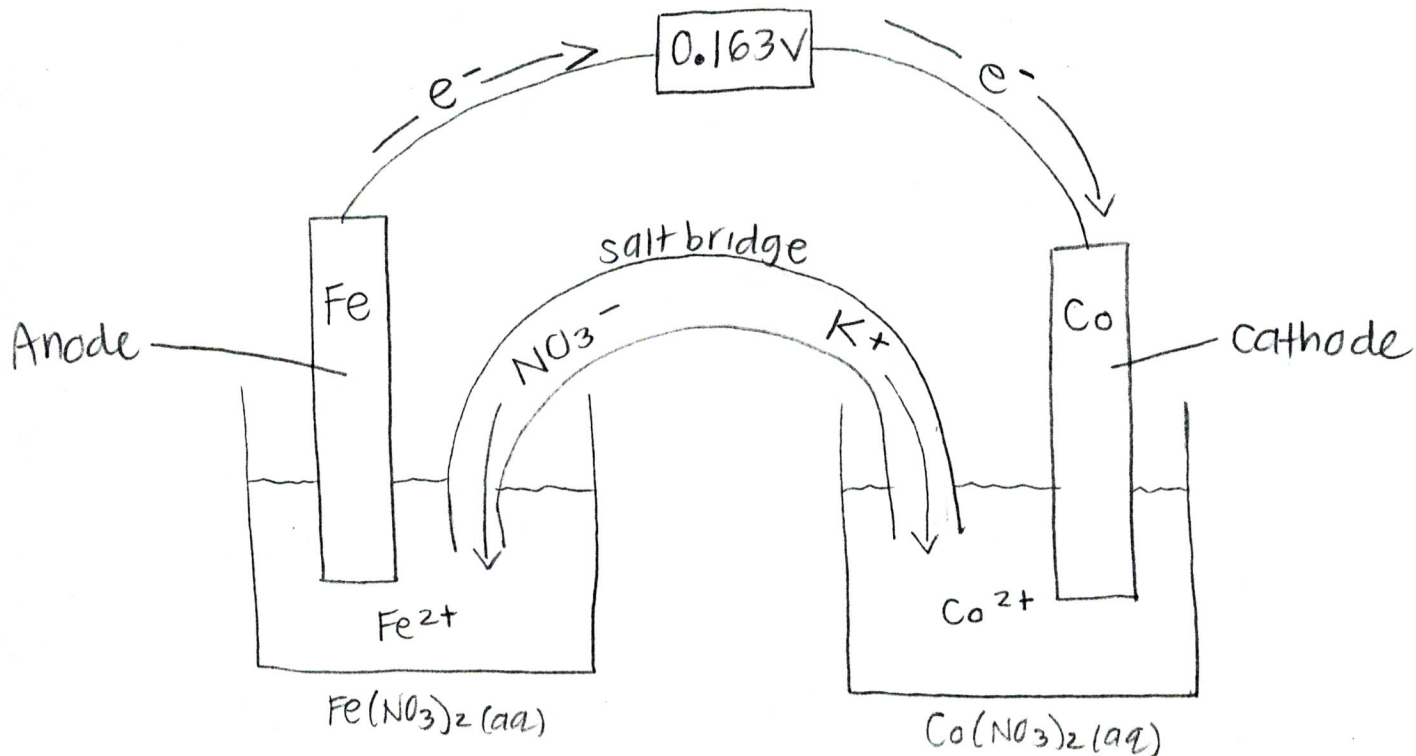


$$\text{Overall: } E^\circ_{\text{cell}} = 0.154 \text{ V} - 0.340 \text{ V} = \boxed{-0.186 \text{ V}}$$

## Part B

1. Since  $E^{\circ}_{\text{cell}}$  is positive, then it is a voltaic cell.
  - a) thermodynamically favorable (spontaneous)
  - b)  $\Delta G^{\circ}$  is negative
  - c)  $K_{\text{eq}} > 1$
  - d) rxn is product favored
2. Since  $E^{\circ}_{\text{cell}}$  is positive, then it is a voltaic cell.
  - a) thermodynamically favorable (spontaneous)
  - b)  $\Delta G^{\circ}$  is negative
  - c)  $K_{\text{eq}} > 1$
  - d) rxn is product favored
3. Since  $E^{\circ}_{\text{cell}}$  is positive, then it is a voltaic cell.
  - a) thermodynamically favorable (spontaneous)
  - b)  $\Delta G^{\circ}$  is negative
  - c)  $K_{\text{eq}} > 1$
  - d) rxn is product favored.
4. Since  $E^{\circ}_{\text{cell}}$  is negative, then it is an electrolytic cell.
  - a) NOT thermodynamically favorable (nonspontaneous)
  - b)  $\Delta G^{\circ}$  is positive
  - c)  $K_{\text{eq}} < 1$
  - d) rxn is reactant favored

## Part C



- ★ Remember : Anode = oxidation  
Cathode = Reduction  
 $e^-$  flow from anode  $\rightarrow$  cathode  
salt bridge / porous disk is made of  
either  $\text{KNO}_3(\text{aq})$  or  $\text{NaNO}_3(\text{aq})$

## Part D

$$1. \Delta G^\circ = -nFE^\circ_{\text{cell}} = -(2 \text{ mol } e^-)(96485 \frac{\text{J}}{\text{mol}\cdot\text{V}})(0.163 \text{ V})$$

$$\Delta G^\circ = -3.15 \times 10^4 \text{ J}$$

$$\Delta G = -RT \ln(K_{\text{eq}})$$

$$-3.15 \times 10^4 \text{ J} = -(8.31 \frac{\text{J}}{\text{K}})(298 \text{ K}) \ln(K_{\text{eq}})$$

$$\ln(K_{\text{eq}}) = 12.7$$

$$K_{\text{eq}} = e^{12.7} = 3.34 \times 10^5$$

$$2. \Delta G^\circ = -(2 \text{ mol } e^-)(96485 \frac{\text{J}}{\text{mol}\cdot\text{V}})(1.057 \text{ V})$$

$$\Delta G^\circ = -2.040 \times 10^5 \text{ J}$$

$$-2.040 \times 10^5 \text{ J} = -(8.31 \frac{\text{J}}{\text{K}})(298 \text{ K}) \ln(K_{\text{eq}})$$

$$\ln(K_{\text{eq}}) = 82.366$$

$$K_{\text{eq}} = 5.976 \times 10^{35}$$

$$3. \Delta G^\circ = -(1 \text{ mol } e^-)(96485 \frac{\text{J}}{\text{mol}\cdot\text{V}})(1.02 \text{ V})$$

$$\Delta G^\circ = -9.84 \times 10^4 \text{ J}$$

$$-9.84 \times 10^4 \text{ J} = -(8.31 \frac{\text{J}}{\text{K}})(298 \text{ K}) \ln(K_{\text{eq}})$$

$$\ln(K_{\text{eq}}) = 39.7$$

$$K_{\text{eq}} = e^{39.7} = 1.82 \times 10^{17}$$

$$4. \Delta G^\circ = - (2 \text{ mol } e^-) \left( 96485 \frac{\text{J}}{\text{mol} \cdot \text{V}} \right) (-0.186 \text{ V})$$

$$\Delta G^\circ = 3.59 \times 10^4 \text{ J}$$

$$3.59 \times 10^4 \text{ J} = - \left( 8.31 \frac{\text{J}}{\text{K}} \right) (298 \text{ K}) \ln(K_{\text{eq}})$$

$$\ln(K_{\text{eq}}) = 14.5$$

$$K_{\text{eq}} = e^{14.5} = 1.97 \times 10^6$$

### Part E

$$1. E_{\text{cell}} = E^\circ_{\text{cell}} - \frac{0.0257}{n} \ln Q$$

$$Q = \frac{[\text{Fe}^{2+}]^1}{[\text{Co}^{2+}]^1} = \frac{(1 \text{ M})^1}{(0.10 \text{ M})^1} = 10$$

$$E_{\text{cell}} = 0.163 \text{ V} - \frac{0.0257}{2} \ln(10)$$

$$E_{\text{cell}} = 0.133 \text{ V}$$

voltage decreases due to larger  
 $\frac{\text{product}}{\text{reactant}}$  ratio.

$$2. Q = \frac{[\text{Ni}^{2+}]^1}{[\text{Ag}^+]^2} = \frac{(0.20 \text{ M})^1}{(1 \text{ M})^2} = 0.20$$

$$E_{\text{cell}} = 1.057 \text{ V} - \frac{0.0257}{2} \ln(0.20)$$

$$E_{\text{cell}} = 1.078 \text{ V}$$

voltage increases due to smaller  
 $\frac{\text{product}}{\text{reactant}}$  ratio.

$$3. \quad Q = \frac{[\text{Co}^{2+}]^1 [\text{Ag}^+]^1}{[\text{Co}^{3+}]^1} = \frac{(1.10 \text{ M})^1 (1 \text{ M})^1}{(1 \text{ M})^1} = 1.10$$

$$E_{\text{cell}} = 1.02 \text{ V} - \frac{0.0257}{1} \ln(1.10)$$

$$E_{\text{cell}} = 1.02 \text{ V}$$

voltage decreases due to larger  
 $\frac{\text{product}}{\text{reactant}}$  ratio.

$$4. \quad Q = \frac{[\text{Sn}^{2+}]^1 [\text{Cu}^{2+}]^1}{[\text{Sn}^{4+}]^1} = \frac{(0.10 \text{ M})^1 (0.30 \text{ M})^1}{(0.40 \text{ M})^1} = 0.075$$

$$E_{\text{cell}} = -0.186 \text{ V} - \frac{0.0257}{2} \ln(0.075)$$

$$E_{\text{cell}} = -0.153 \text{ V}$$

voltage increases due to smaller  
 $\frac{\text{product}}{\text{reactant}}$  ratio.