2A,

2. Answer the following questions that relate to electrochemical reactions.

(a) Under standard conditions at 25°C, $Zn(s)$ reacts with $Co^{2+}(aq)$ to produce $Co(s)$.

(i) Write the balanced equation for the oxidation half reaction.

(ii) Write the balanced net-ionic equation for the overall reaction.

(iii) Calculate the standard potential, $E°$, for the overall reaction at 25°C.

(b) At 25°C, H_2O_2 decomposes according to the following equation.

$$2\,H_2O_2(aq) \rightarrow 2\,H_2O(l) + O_2(g) \qquad E° = 0.55\ V$$

(i) Determine the value of the standard free energy change, $\Delta G°$, for the reaction at 25°C.

(ii) Determine the value of the equilibrium constant, K_{eq}, for the reaction at 25°C.

(iii) The standard reduction potential, $E°$, for the half reaction $O_2(g) + 4\,H^+(aq) + 4\,e^- \rightarrow 2\,H_2O(l)$ has a value of 1.23 V. Using this information in addition to the information given above, determine the value of the standard reduction potential, $E°$, for the half reaction below.

$$O_2(g) + 2\,H^+(aq) + 2\,e^- \rightarrow H_2O_2(aq)$$

(c) In an electrolytic cell, $Cu(s)$ is produced by the electrolysis of $CuSO_4(aq)$. Calculate the maximum mass of $Cu(s)$ that can be deposited by a direct current of 100. amperes passed through 5.00 L of 2.00 M $CuSO_4(aq)$ for a period of 1.00 hour.

2. a) i) $Zn(s) \rightarrow Zn^{+2}(aq) + 2e^-$

ii) $Zn(s) + Co^{+2}(aq) \rightarrow Zn^{+2}(aq) + Co(s)$

iii) $Zn(s) \rightarrow Zn^{+2}(aq) + 2e^-$ 0.76 V.

$Co^{+2}(aq) + 2e^- \rightarrow Co(s)$ −0.28 V.

$Zn(s) + Co^{+2}(aq) \rightarrow Zn^{+2}(aq) + Co(s)$

$E° = 0.76\,V. + (-0.28\,V.)$

$E° = 0.48\,V.$

b) i) $\Delta G° = -nFE°$

n = number of moles of electrons transferred

$\Delta G° = -(2\ \text{moles electrons})\left(96{,}500\ \frac{J}{V \cdot \text{mole electrons}}\right)(0.55\ V) = -1.1 \times 10^5\ J$

GO ON TO THE NEXT PAGE.