Name Key

Cell Potential: The Nernst Equation

1. A galvanic cell is based on the following half-reactions at 25°C:

$$Ag^+ + e^- \longrightarrow Ag$$
$$H_2O_2 + 2H^+ + 2e^- \longrightarrow 2H_2O$$

$E_{cell} = E^\circ_{cell} - \frac{.0591}{n} \log Q$

$2Ag \rightarrow 2Ag^+ + 2e^- \quad -.80$

$2Ag + H_2O_2 + 2H^+ \rightarrow 2H_2O + 2Ag^+ \quad +.98$

Calculate E_{cell} for the cell in the following situations.

a. $[Ag^+] = 1.0$ M, $[H_2O_2] = 2.0$ M, $[H^+] = 2.0$ M

b. $[Ag^+] = 2.0$ M, $[H_2O_2] = 1.0$ M, $[H^+] = 1.0 \times 10^{-7}$ M

a) $E_{cell} = .98 - \frac{.0591}{2} \log \frac{1^2}{(2)(2^2)}$

$E_{cell} = .98 - .02955 \log(.125)$

$= .98 - .02955(-.90)$

$= 1.01$ V

b) $E_{cell} = .98 - \frac{.0591}{2} \log \frac{2^2}{(1)(1\times10^{-7})^2}$

$E_{cell} = .98 - .4315$

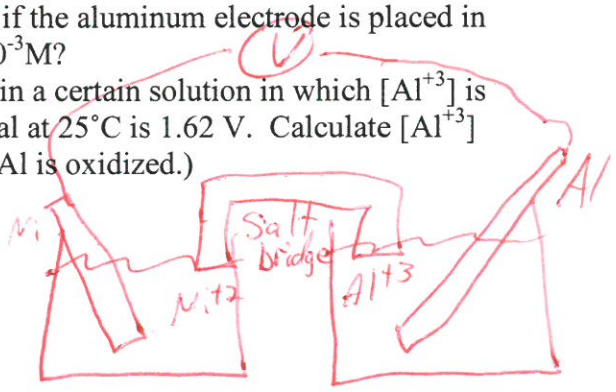
$E_{cell} = .55$ V

2. An electrochemical cell consists of a nickel metal electrode immersed in a solution with $[Ni^{+2}] = 1.0$ M separated by a porous disk from an aluminum metal electrode.

a. What is the potential of this cell at 25°C if the aluminum electrode is placed in a solution in which $[Al^{+3}] = 7.2 \times 10^{-3}$M?

b. When the aluminum electrode is placed in a certain solution in which $[Al^{+3}]$ is unknown, the measured cell potential at 25°C is 1.62 V. Calculate $[Al^{+3}]$ in the unknown solution. (Assume Al is oxidized.)

c. Make a sketch of this cell.



$\times 3 \quad Ni^{+2} + 2e^- \rightarrow Ni \quad -.26$

$\times 2 \quad Al^{+3} + 3e^- \rightarrow Al \quad -1.66$

$3Ni^{+2} + 6e^- \rightarrow 3Ni \quad -.26$

$2Al \rightarrow 2Al^{+3} + 6e^- \quad +1.66$

$3Ni^{+2} + 2Al \rightarrow 2Al^{+3} + 3Ni \quad 1.4$ V

a) $E_{cell} = 1.4 - \frac{.0591}{6} \log \frac{(7.2\times10^{-3})^2}{(1^3)}$

$E_{cell} = 1.4 - .0422 = 1.44$ V

B) $1.62 = 1.4 - \frac{.0591}{6} \log \frac{x^2}{(1^3)}$

$.22 = -.00985 \log x^2$

$-22.335 = \log x^2$

$x^2 = 4.62\times10^{-23}$

$x = 6.8\times10^{-12}$ M $[Al^{+3}]$