Elektro, Øving 7, Vegard G. Jervell

1) Elektro kan hjelpe ved å utvikle tek. som gjør det enklelt å lagre energi fra ustabile kilder (sol/vind) F.eks. Li-ion batteri, Vanadiumcellen osv.

2) $E = \frac{\Delta G}{zF} = \frac{1}{zF} \ln\left(\frac{a_{Li^+} \cdot a_{Br^-}(0{,}5M)}{a_{Li^+} \cdot a_{Br^-}(0{,}1M)}\right)$

$a_{Li^+} \cdot a_{Br^-} = C^2 \gamma_{Li^+} \gamma_{Br^-}$, $\gamma_i = \exp\left(-|z_i|^2 \sqrt{\frac{\mu}{\mu_{DH}}}\right)$

$\mu_{DH} = 0{,}727M$

$\mu(0{,}5M) = \frac{1}{2}(0{,}5 + 0{,}5) = 0{,}5$

$\mu(0{,}1M) = 0{,}1$

$\gamma_{Li^+}(0{,}5M) = \gamma_{Br^-}(0{,}5M) = 0{,}44$

$\gamma_{Li^+}(0{,}1M) = \gamma_{Br^-}(0{,}1M) = 0{,}69$

$E = \frac{1}{F} \ln\left(\frac{0{,}5^2 \cdot 0{,}44^2}{0{,}1^2 \cdot 0{,}69^2}\right) =$

2a)

$\Delta\Phi = \Phi_2 - \Phi_1 = \frac{RT}{F(u_+ - u_-)}\left(\frac{u_+}{z_+} - \frac{u_-}{z_-}\right)\ln\left(\frac{c_2}{c_1}\right)$

$u_- = -80{,}9 \cdot 10^9\ m^2 V^{-1} s^{-1}$ $\quad c_2 = 0{,}5$, $c_1 = 0{,}1$

$u_+ = 40{,}97 \cdot 10^9\ m^2 V^{-1} s^{-1}$

$\Delta\Phi = -14mV$

2b) Tvivelt: Samme løsning/koncentration på begge sider:

$\Delta G = \Delta\Phi = 0$

2c)

$$\Delta\Phi = \frac{RT}{F(u_+ - u_-)}\left(\frac{u_+}{z_+} - \frac{u_-}{z_-}\right)\ln\left(\frac{c_2}{c_1}\right)$$

$u_+ = 76{,}2\ nm^2V^{-1}s^{-1}$ $\quad z_+ = 1,\ z_- = -1$

$u_- = -79{,}1\ nm^2V^{-1}s^{-1}$

$\Delta\Phi = -77\,mV$

3a) $E = -\frac{\Delta G}{n_e F} = -\frac{1}{zF}(\Delta H - T\Delta S)$, antar $\frac{\partial G}{\partial T} = 0$

$$\frac{\partial E}{\partial T} = +\frac{\Delta S}{zF} = (2\cdot 57 + 2\cdot 0 - [131 + 223])\frac{1}{zF}$$

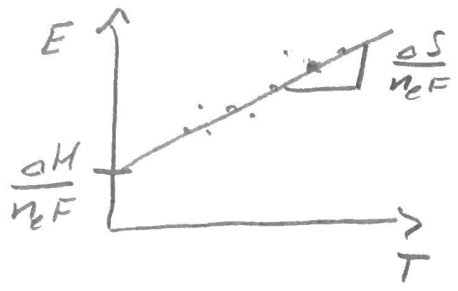
$$\frac{\partial E}{\partial T} = -1{,}234\,\frac{mV}{K}$$

3b) $$\frac{\partial E}{\partial T} = \frac{+\Delta S}{zF} = +\frac{(70 - (131 + 0{,}5\cdot 205))}{zF} = -0{,}85\,\frac{mV}{K}$$

3c) $\Delta S = S_{CO(g)} - S_{C(s)} - \frac{1}{2}S_{O_2(g)}$

$$\frac{\partial E}{\partial T} = \frac{\Delta S}{zF} = 0{,}45\,\frac{mV}{K}$$

3d) $E^\circ = -\frac{\Delta G^\circ}{n_e F} = \frac{T\Delta S^\circ - \Delta H^\circ}{n_e F}$



$\frac{\Delta H}{n_e F} = E(T_{rif}) - T\frac{\partial E}{\partial T}$

$\Delta H = n_e F\left(E(T_{rif}) - T\frac{\partial E}{\partial T}\right)$

Oppg. 5a)

$$-Zn(s)\,|\,ZnSO_4(aq)^{\alpha}\,|\,ZnSO_4(aq)^{\beta}\,|\,Zn'(s)+$$

$Zn(s) + Zn^{2+}(\beta) \leftrightharpoons Zn'(s) + Zn^{2+}(\alpha)$

$\Delta G = RT\ln\left(\frac{a_{Zn^{2+}_\alpha}}{a_{Zn^{2+}_\beta}}\right) < 0$, Fordi $Zn^{2+}_{(\beta)}$ reduseres

$\rightarrow a_{Zn^{2+}_\alpha} < a_{Zn^{2+}_\beta} \rightarrow c_{Zn^{2+}_\alpha} < c_{Zn^{2+}_\beta}$

Oppg. 5b) $Zn(s) + Zn^{2+}(\beta) + SO_4^{2-}(\beta) \rightarrow Zn'(s) + Zn^{2+}(\alpha) + SO_4^{2-}(\alpha)$

Oppg. 5c) $E = -\frac{\Delta G}{nF}$ $\quad \Delta\phi = E = \frac{RT}{F(u_+ - u_-)}\left(\frac{u_+}{z_+} - \frac{u_-}{z_-}\right)\ln\left(\frac{c_\beta}{c_\alpha}\right)$

Husk $t_i = \frac{\nu_i z_i u_i}{\sum \nu_i z_i u_i} = \frac{c_i z_i u_i}{\sum c_i z_i u_i} \rightarrow u_i = \frac{t_i \sum_j c_j z_j u_j}{c_i z_i}$

$u_i(1-t_i) = t_i \sum_{j\neq i} \frac{c_j z_j}{c_i z_i} u_j$ Får ikke tid til å skrive

$u_i = \frac{t_i}{1-t_i} \sum_{j\neq i} \frac{c_j z_j}{c_i z_i} u_j$ Sparre i øvingstime

Oppg. 6)

$$Ni(s) + Ni^{2+}(\beta) + 2Cl^-(\beta) \rightarrow Ni'(s) + Ni^{2+}(\alpha) + 2Cl^-(\alpha)$$

$$t_+ Ni^{2+}(\beta) \rightarrow t_+ Ni^{2+}(\alpha)$$

$$2t_- Cl^-(\alpha) \rightarrow 2t_- Cl^-(\beta)$$

$$2e^-(Ni') + Ni^{2+}(\beta) + 2t_- Cl^-(\beta) + t_+ Ni^{2+}(\alpha) + Ni(s) \rightarrow Ni'(s) + 2t_- Cl^-(\alpha) + t_+ Ni^{2+}(\beta) + Ni^{2+}(\alpha) + 2e^-(Ni)$$

$$2e^-(Ni') + t_- Ni^{2+}(\beta) + 2t_- Cl^-(\beta) + Ni(s) \rightarrow Ni'(s) + 2t_- Cl^-(\alpha) + t_- Ni^{2+}(\alpha) + 2e^-(Ni)$$

$$\sum \nu_i \tilde{\mu}_i = 0, \quad \mu_{Ni} = \mu_{Ni'}$$

$$\Delta G^\circ + RT \ln\left(\frac{[a_{Cl^-(\alpha)}]^{2t_-}[a_{Ni^{2+}(\alpha)}]^{t_-}}{[a_{Cl^-(\beta)}]^{2t_-}[a_{Ni^{2+}(\beta)}]^{t_-}}\right) + 2(-1)F\phi_{Ni} - 2(-1)F\phi_{Ni'} = 0$$

$$a_{i^{\gamma(\gamma)}} \approx a_{j^{-(\gamma)}} \approx a_{\pm(\gamma)}$$

$$\phi_{Ni} - \phi_{Ni'} = -\Delta\phi = \frac{RT}{2F} \ln\left(\frac{a_{\pm(\alpha)}^{3t_-}}{a_{\pm(\beta)}^{3t_-}}\right)$$

$$\Delta\phi = -\frac{3RTt_-}{2F} \ln\left(\frac{a_{\pm(\alpha)}}{a_{\pm(\beta)}}\right), \quad t_- = \frac{\nu_- \lambda_-}{\nu_- \lambda_- + \nu_+ \lambda_+}, \quad \lambda_- = \lambda_{Cl^-} = 7{,}6 \cdot 10^{-3}, \quad \lambda_+ = \lambda_{Ni^{2+}} = 10 \cdot 10^{-3}$$

$$t_- = 0{,}6$$

$$\Delta\phi = 53\,mV$$

Oppg. 7) Skjønner ikke hva oppg spør om... med presisjon 0,001 har man Selvfølgelig en presisjon på 0,001 (gitt riktig kalibrering) gir ikke mening å selge apparater med avlesning på $0{,}001 \pm 0{,}01$ ...