Elektro, Øving 5, Vegard G. Jervell

2b)

$$pV = nRT$$
$$p = \frac{n}{V}RT = \frac{\rho}{M}RT$$
$$\rightarrow \underline{\rho = \frac{pM}{RT}}$$

$$-dp = \rho g\, dh$$
$$-dp = \frac{pMg}{RT} dh$$
$$\ln\left(\frac{p}{p_0}\right) = -\frac{Mg}{RT}(h-h_0)$$
$$(*) \quad p = p_0 \exp\left(-\frac{Mg}{RT}h\right), \quad h_0 = 0$$
$$\rightarrow \underline{\underline{p = 31{,}42\text{ kPa}}}$$

2c) Forventer høyere enn 21% fordi

$M_{O_2} < \bar{M}_{luft} \rightarrow p_{O_2} > \bar{p}_{luft}$ fra (*)

↑ gjennomsnittlig partialtrykk

3a) $\overset{+I}{Hg_2}\overset{-I}{Cl_2}$, $\overset{+I}{H_2}\overset{-II}{O}$, $\overset{0}{H_2}$

$\overset{0}{Hg}$, $\overset{+I}{H_3}\overset{-II}{O^+}$, $\overset{-I}{Cl^-}$

3b) $N_2H_4(l) + O_2(g) \rightarrow N_2(g) + 2H_2O(l)$

3c) $Zn(s) + MnO_2(s) + NH_4^+(aq) + Cl^-(aq)$
$\rightarrow MnOOH(s) + Zn(NH_3)_2Cl_2(s)$

I) $MnO_2 + NH_4^+ + e^- \rightarrow MnOOH + NH_3$

II) $Zn + 2NH_3 + 2Cl^- \rightarrow Zn(NH_3)_2Cl_2 + 2e^-$

Total: $Zn + 2MnO_2 + 2NH_4^+ + 2Cl^-$
$\rightarrow 2MnOOH + Zn(NH_3)_2 + Cl_2$

4a) $\Delta_{rx} G = \sum \nu_i G_i = \sum \nu_i (H_i - TS_i)$

Tabellverdier

-1 For reaktanter
+1 For produkter } i denne reaksjonen

$\Delta_{rx} G = -623 \, kJ/mol$

$$E^\circ = \frac{+RT}{2n_e F} \ln(K) = \frac{+RT}{2n_e F}\left(\frac{-\Delta_{rx} G^\circ}{RT}\right)$$

$$E^\circ = \frac{-\Delta_{rx} G^\circ}{2n_e F} = \frac{623 \frac{kJ}{mol}}{2 \cdot 2 mol \cdot F} = 1{,}6 \frac{J}{C} = 1{,}6 V$$

4b) $\Delta_{rx} G = -RT \ln(K)$

$\Delta_{rx} G = 22{,}39 \frac{kJ}{mol}$

5a) $W = Q \Delta \Phi = 340 mC \cdot (-281 mV) = -95{,}5 mJ$

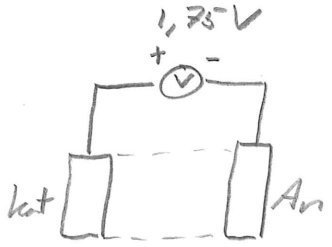
$\Delta G = \underbrace{\Delta \mu}_{=0} + \underbrace{nF}_{=Q} \Delta \Phi \rightarrow \Delta G = -95{,}5 mJ$

$\Delta G = \underbrace{\Delta \mu}_{=0} + nF \Delta \Phi$

$\Delta G = 96485 \frac{C}{mol} \cdot 2 mol \cdot (-281 mV)$

$\Delta G = 27 kJ$

5b)



$$\Delta\tilde{\mu} = (\tilde{\mu}_1 - \tilde{\mu}_2) = 0$$

$$= \cancel{RT\ln\left(\frac{a_1}{a_2}\right)} + F(\Phi_1 - \Phi_2)$$

$$= F\Delta\Phi$$

$$\underline{\Delta\tilde{\mu} = 168\ \text{kJ mol}^{-1}}$$

6a) $\gamma_i = \exp\left(-z_i^2\sqrt{\frac{\mu}{\mu_{DH}}}\right)$, $\mu_{DH} = (2\pi N_A)^2\left(\frac{2RT\varepsilon}{F^2}\right)^3$

$\mu_{DH} = 727\ \text{mM}$, for (aq) v/ 298K

$\mu = \frac{1}{2}\sum z_i^2 c_i = c$ for KNO_3

$\underline{\gamma_{NO_3^-} = \gamma_{K^+}(c = 10^{-5}) = 0{,}996}$

$\underline{\gamma_{NO_3^-}(c = 10^{-3}) = \gamma_{K^+}(c = 10^{-3}) = 0{,}96}$

$\underline{\gamma_{NO_3^-}(c = 0{,}1M) = \gamma_{K^+}(c = 0{,}1M) = 0{,}69}$

Løsning av KNO_3 og 0,1M $HClO_4$

$\underline{\mu = \frac{1}{2}\sum z_i^2 c_i = c_{KNO_3} + 0{,}1}$, $\underline{\mu(c_{KNO_3} = 10^{-3}) = 0{,}101}$

$\underline{\gamma_{NO_3^-}(c = 10^{-3}M) = \gamma_{K^+}(c = 10^{-3}M) = 0{,}69}$

Oppg. 6b) $2H_2O \rightleftharpoons H_3O^+ + OH^-$. $\Delta_{rx}G = 79{,}9 \frac{kJ}{mol}$ v/ 298K

$$K_w = \exp\left(\frac{-\Delta_{rx}G^\circ}{RT}\right)$$, antar $\Delta_{rx}G^\circ = \Delta_{rx}G^\circ(298K)$

	T = 50°C	100°C	150°C
K_w	$1{,}2 \cdot 10^{-13}$	$6{,}5 \cdot 10^{-12}$	$1{,}4 \cdot 10^{-10}$

$$K_w = \left(\frac{a_{H_3O^+}\, a_{OH^-}}{a_{H_2O}^2}\right) = \left(a_{H_3O^+}\, a_{OH^-}\right)$$, antar $a_{H_2O} = 1$

$C_{H_3O^+} = C_{OH^-}$, antar $\gamma_{H_3O^+} = \gamma_{OH^-} = 1$

$$K_w = C_{H_3O^+}^2 \rightarrow C_{H_3O^+} = \sqrt{K_w}$$

$$pH = -\log C_{H_3O^+} = -\frac{1}{2}\log K_w$$

	50°C	100°C	150°C
pH	6,46	5,59	4,93

For alle temperaturer er $C_{H_3O^+} < 10^{-4{,}93}$
$\rightarrow \gamma_{H_3O^+} = 1$ virker som en grei antakelse

Oppg. 7a) $C_{Pb^{2+}} = C_{SO_4^{2-}} = 0{,}14\,mmol\,L^{-1}$

$$\mu = \frac{1}{2}\sum z_i^2 c_i = 5{,}6 \cdot 10^{-4}$$

$$\gamma_\pm = \exp\left(z_+ z_- \sqrt{\frac{\mu}{\mu_{DH}}}\right)$$, $\mu_{DH} = 727\,mM$ v/ 25°C

$$\gamma_\pm = 0{,}89$$

Oppg. 7b) $K_{sp} = a_{Pb^{2+}} \, a_{SO_4^{2-}} = \gamma_\pm^2 C^2$

$$\underline{\underline{K_{sp} = 1{,}55 \cdot 10^{-8}}}$$

Oppg. 7c) $\Delta_{rx} G^\circ = -RT \ln(K_{sp})$, antar $T = 298K$

$$\underline{\underline{\Delta_{rx} G^\circ = 44 \, \frac{kJ}{mol}}}$$