LF eksempelsemesterprøve 2, kap 9-11

1. Def.

2. Varme ut av beholderen, indre energi avtar

$$E = H - PV . \quad PV - konst$$
$$ H - avtar$$
$$ \Rightarrow E - avtar$$

3. Def $\quad w = -P\Delta V$

   se ellers boka

4. $\Delta_f H^\circ = 2 \text{ kJ/mol}$

5. $\Delta H^\circ = 3.227 \text{ kJ} - 49 \text{ kJ} = \underline{\underline{632 \text{ kJ}}}$

6. $\quad H_2O (l) \rightarrow H_2O (s) \qquad \Delta C_p = (2.02 - 4.184) \text{ J/kg} = -2.164 \text{ J/kg}$

   $\Delta H_1 = 40.66 \text{ kJ/mol}$

   $\Delta H_2 = \Delta C_p \cdot m \cdot \Delta T$
   $ = -2.164 \text{ J/kg} \cdot 18.025 \text{ J/mol} \cdot (340.2 - 373.3)K$
   $ = 1290.7 \text{ J/mol}$
   $ = 1.29 \text{ kJ/mol}$

   $\Delta H = \Delta H_1 + \Delta H_2 = 40.66 \text{ kJ/mol} + 1.29 \text{ kJ/mol} = \underline{\underline{41.95 \text{ kJ/mol}}}$

7. $\downarrow q$

   $\boxed{}$

   $E = q + w \qquad P\Delta V = \Delta n RT \qquad \Delta n = 1.5 \text{ mol}$
   $ = q - P\Delta V$
   $ = q - \Delta n RT$
   $ = +285.8 \text{ kJ/mol} - 1.5 \text{ mol} \cdot 8.31451 \text{ J/K mol} \cdot 298 K \cdot \frac{1 \text{ kJ}}{1000 \text{ J}}$
   $ = \underline{\underline{282.1 \text{ kJ}}}$

8. $A_2 (g) + B_2 (g) \rightarrow 2 AB(g)$
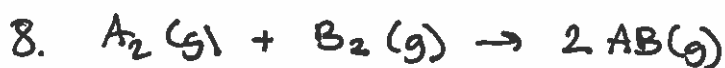
$\Delta H < 0$ pga bindingsenergi (bindes sterkere $\Rightarrow$ energi må
frigjøres $\Rightarrow$ Trenger mer energi for å bryte)

$\Delta S > 0$ pga antall gassmolekyler.

9. a) spontan
   b) $AB(s) \rightarrow A^+ + B^-$ krever energi
   c) spontan pga tyngdekraft
   d) blandes vha bevegelse i væsker, ingen bindinger d.l. som brytes.

10. $\Delta S_{surr} = - \dfrac{\Delta H}{T}$

$= - \dfrac{-2221 \text{ kJ}}{298 \text{K}} = 7,453 \text{ kJ/K} = 7453 \text{ J/K}$

11. $\Delta G^\circ = -394 \text{ kJ} + 2 (-237 \text{ kJ}) - (-51 \text{ kJ}) - 2 \cdot 0$

$= -817 \text{ kJ}$

12. $\Delta G^\circ = \Delta H^\circ - T \Delta S^\circ = 0$ $\qquad \phi \; Hg (l) \rightarrow Hg (g)$

$\Rightarrow T = \dfrac{\Delta H^\circ}{\Delta S^\circ} = \dfrac{58,51 \cdot 10^3 \text{ J/mol}}{92,92 \text{ J K}^{-1} \text{mol}^{-1}} = 629,7 \text{ K}$

13. $\Delta G^\circ = - RT \ln K$

$= - RT \ln \dfrac{P_{NF_2}^2}{P_{N_2} \cdot P_{F_2}^3}$

$= - 8,31451 \text{ J/K mol} \cdot 800 \text{K} \cdot \ln \left(\dfrac{0,48^2}{0,021 \cdot 0,063^3} \right)$

$= -71100 \text{ J}$

$= -71,1 \text{ kJ}$

14.

$$\Delta G° = \Delta H° - T\Delta S° = -RT \ln K$$

$$\ln K = \frac{\Delta H° - T\Delta S°}{-RT} = \frac{-58{,}03 \cdot 10^3 \, J/mol - 373K \cdot (-176{,}6 \, J/Kmol)}{-8{,}31451 \, J/Kmol \cdot 373K}$$

$$= -2{,}529$$

$$\Rightarrow \underline{\underline{K = 0{,}0798}}$$

15.

$$P_1 \rightarrow P_2$$

$$1atm \qquad 0{,}1atm$$
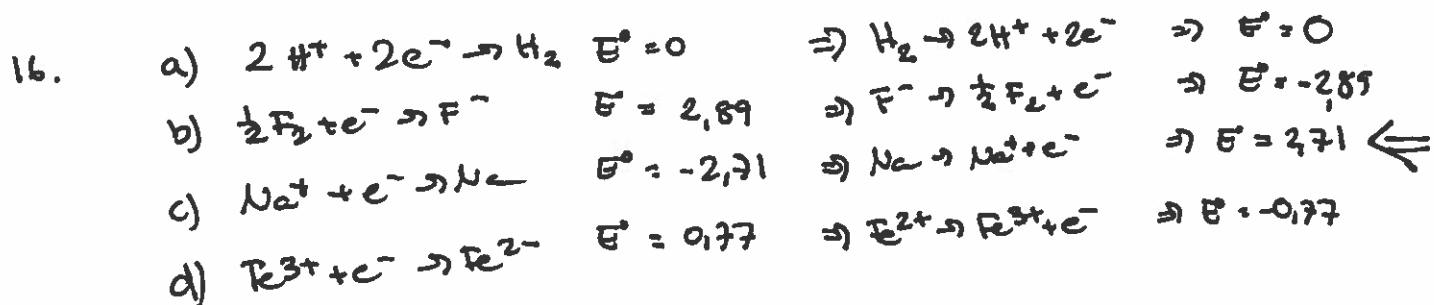
$$\Delta G° = -RT \ln K$$

$$= -RT \ln \frac{0{,}1}{1}$$

$$= -8{,}31451 \, J/K \cdot 298K \cdot \ln \frac{0{,}1}{1}$$

$$= 5705 \, J$$

$$= \underline{\underline{5{,}7 \, kJ}}$$

16.

a) $2H^+ + 2e^- \rightarrow H_2 \quad E° = 0 \qquad \Rightarrow H_2 \rightarrow 2H^+ + 2e^- \quad \Rightarrow E° = 0$

b) $\frac{1}{2}F_2 + e^- \rightarrow F^- \quad E = 2{,}89 \qquad \Rightarrow F^- \rightarrow \frac{1}{2}F_2 + e^- \quad \Rightarrow E = -2{,}89$

c) $Na^+ + e^- \rightarrow Na \quad E° = -2{,}71 \qquad \Rightarrow Na \rightarrow Na^+ + e^- \quad \Rightarrow E = 2{,}71 \Leftarrow$

d) $Fe^{3+} + e^- \rightarrow Fe^{2-} \quad E = 0{,}77 \qquad \Rightarrow Fe^{2+} \rightarrow Fe^{3+} + e^- \quad \Rightarrow E = -0{,}77$

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a) $E° = -2{,}71 \, V + (-2{,}89 \, V) = -5{,}6 \, V \qquad \div$

b) Fellingsrx, ikke red.oks $\qquad \div$

c) $E° = 0{,}34 \, V + 2{,}36 \, V = 2{,}7 \, V \qquad +$

d) $E° = -0{,}76 \, V + 0{,}24 \, V = -0{,}52 \, V \qquad \div$

18. $\Delta G° = -nFE°$

$\Rightarrow E° = \div \dfrac{\Delta G°}{nF}$ $n = 6$

$= \div \dfrac{-702 \cdot 10^{3} J}{6 \cdot 96485 C} = \underline{\underline{1{,}21 \ V}}$

19. $Al^{3+} + 3e^- \rightarrow Al$ $-1{,}68 V$

   $Pb^{2+} + 2e^- \rightarrow Pb$ $-0{,}13 V$ $n = 6$

$\Rightarrow 2Al + 3Pb^{2+} \rightarrow 2Al^{3+} + 3Pb$ $(E° = 1{,}55 V)$
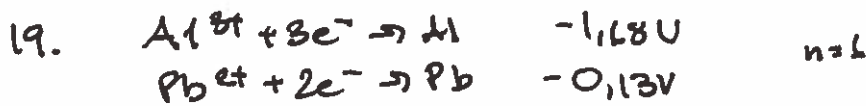
$\Rightarrow$ oppgitt $\underline{1{,}53 V}$ for ry
i oppgaven. Bruker denne.

$E = E° - \dfrac{0{,}0592}{n} \cdot \log Q$

$[Al^{3+}] = 1{,}0 M + 0{,}6 M = 1{,}6 M$

$[Pb^{2+}] = 1{,}0 M - 0{,}6 \cdot \dfrac{3}{2} M = 0{,}1 M$

$E = 1{,}53 V - \dfrac{0{,}0592}{6} \cdot \log\left(\dfrac{1{,}6^2}{0{,}1^3}\right) = \underline{\underline{1{,}50 V}}$

$\left(\begin{array}{l} n_{Al^{3+}} = 0{,}6 \ mol \ blit \quad V = 1 L \\[4pt] \text{Reag. Pb:} \ n_{Pb^{2+}} = n_{Al^{3+}} \cdot \dfrac{3}{2} = 0{,}6 \ mol \cdot \dfrac{3}{2} = 0{,}9 \ mol \\[4pt] \Rightarrow [Pb^{2+}] = \dfrac{\Delta n}{V} = \dfrac{(1 - 0{,}9) \ mol}{1 L} = 0{,}1 M \end{array}\right)$

20. $Ag_2SO_4 \rightleftharpoons 2Ag^+ + SO_4^{2-}$ $K_{sp} = [Ag^+]^2 \cdot [SO_4^{2-}]$

$Pb \rightarrow Pb^{2+} + 2e^-$

$Ag^+ + e^- \rightarrow Ag$ $| \cdot 2$

$\overline{Pb + 2Ag^+ \rightarrow Pb^{2+} + 2Ag}$
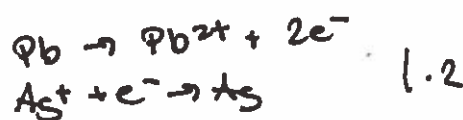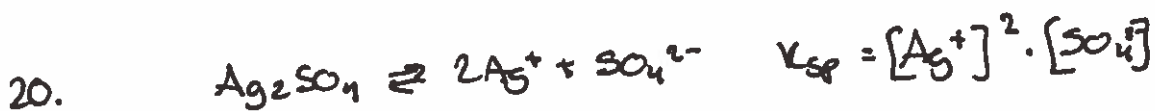
$E = E° - \dfrac{RT}{nF} \cdot \ln \dfrac{[Pb^{2+}]}{[Ag^+]^2}$

$0{,}83 V = 0{,}93 V - \dfrac{8{,}3145 \ J/Kmol \cdot 298K}{2 \cdot 96485 C/mol} \cdot \ln \dfrac{1{,}8}{x^2}$ $\boxed{[Ag^+] = x}$

$X = 0{,}0273$ $Ag_2SO_4 \rightarrow 2Ag^+ + SO_4^{2-}$

   LV: $x \quad \quad \dfrac{x}{2}$
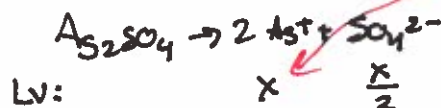
$\Rightarrow K_{sp} = x^2 \cdot \dfrac{x}{2} = 0{,}0273^2 \cdot \dfrac{0{,}0273}{2} = \underline{\underline{1{,}02 \cdot 10^{-5}}}$