s. 19 ① ⓐ $pV = nRT$, $n = \frac{m}{M}$

$10^6 V = \frac{10}{2} \cdot 8{,}314 \cdot (30+273)$

$V = 0{,}0126\ m^3 = 12{,}6\ dm^3$

$dm^3 + kPa$
$m^3 + Pa$
PLYNY

ⓑ $p \cdot 20 = \frac{10}{2} \cdot 8{,}314 \cdot (30+273)$

$p = 629{,}8\ kPa$

② $pV = nRT \Rightarrow p\frac{V}{n} = RT \Rightarrow pV_m = RT$

$100 \cdot V_m = 8{,}314 (25+273)$

$V_m = 24{,}8\ dm^3\ mol^{-1}$

③ ⓐ $\overline{M} = \frac{\%_1 M_1 + \%_2 M_2}{100} = \frac{79 \cdot 28 + 21 \cdot 32}{100} = 28{,}84\ g\ mol^{-1}$

ⓑ $pV = nRT$; $pV = \frac{m}{M}RT$

$2 \cdot 10^3 \cdot 50 = \frac{m}{28{,}84} \cdot 8{,}314 \cdot (40+273) \Rightarrow m = 1108\ g$

c) $p_{O_2} = x_{O_2} \cdot p_{vzd} = 0{,}21 \cdot 2 = 0{,}42\ MPa$

$p_{N_2} = 0{,}79 \cdot 2 = 1{,}58\ MPa$

d) $V_{O_2} = x_{O_2} \cdot V_{vzd} = 0{,}21 \cdot 50 = 10{,}5\ dm^3$

$V_{N_2} = 39{,}5\ dm^3$

e) $n_{O_2} = x_{O_2} \cdot n$; $\frac{m}{M} = n = \frac{1108}{28{,}84} = 38{,}42\ mol$

$n_{O_2} = 8{,}07\ mol$, $n_{N_2} = 30{,}35\ mol$

⑤ $M(Ar) = 39{,}95$ ... pomalejší
$M(Ne) = 20{,}18$ ... rychlejší

$\frac{v_1}{v_2} = \sqrt{\frac{M_2}{M_1}} = \sqrt{\frac{39{,}95}{20{,}18}} = 1{,}41$

⑥ $pV = nRT$

$p \cdot 20 = 50 \cdot 8{,}314 \cdot (25+273) \Rightarrow p = \underline{6194\ kPa}$

$O_2$ . Van der Waals:

$$\left(p + \frac{an^2}{V^2}\right)(V - nb) = nRT$$

$$\left(p + \frac{0{,}138 \cdot 50^2}{(20 \cdot 10^{-3})^2}\right)\left(20 \cdot 10^{-3} - 50 \cdot 31{,}8 \cdot 10^{-6}\right) = 50 \cdot 8{,}314 \cdot 298{,}15$$

$$(p + 862\,500)(\ldots \cdot 0{,}01841 = 123\,936{,}798$$

$$p = 5\,869\,536\ Pa = \underline{5870\ kPa}$$

⑦ $$V_m = \frac{RT}{p} + b - \frac{a}{RT} = \frac{8{,}314 \cdot 298}{101325} + 408 \cdot 10^{-6} - \frac{0{,}372}{8{,}314 \cdot 298} =$$

$$= 0{,}02445 + 408 \cdot 10^{-6} - 0{,}0001501 =$$

$$= 0{,}02464\ m^3 = \underline{24{,}64\ dm^3}$$

Lze též i přesněji, ale to není obtížné.

10.28 Př ⑤ (KAPALINY)

$$\frac{S_1 h_1}{\eta_1} = \frac{S_2 h_2}{\eta_2}$$

$$\frac{1{,}022 \cdot 612{,}5}{\eta_1} = \frac{0{,}998 \cdot 142{,}3}{1{,}005}$$

$$\eta_1 = \frac{1{,}022 \cdot 612{,}5 \cdot 1{,}005}{0{,}998 \cdot 142{,}3}$$

$$\eta_1 = 4{,}4298\ mPa\,s \doteq \underline{4{,}43\ mPa\,s}$$

⑨ $$\sigma = \frac{1}{2} r \varrho g h = \frac{1}{2} \cdot \underbrace{0{,}4 \cdot 10^{-3}}_{m} \cdot \underbrace{871}_{kg\,m^{-3}} \cdot 9{,}81 \cdot 0{,}012$$

$$\sigma = \underline{0{,}0205\ N\,m^{-1}}$$

⑦ $\eta$ … dynamická vistkozita

$\nu = \frac{\eta}{\varrho}$ … kinematická vistkozita

$F_\eta + F_A$ ↑

$F_G$ ↓

$F_G = F_\eta + F_{gA}$

$m_T \cdot g = 6\pi \eta r v + m_V g$

$\varrho_T V g = 6\pi \eta r \frac{0}{t} + \varrho_V V g$

$\varrho_T \frac{4}{3}\pi r^3 g = 6\pi \eta r \frac{0}{t} + \varrho_V \frac{4}{3}\pi r^3 g$

$7820 \cdot \frac{4}{3}\pi (2 \cdot 10^{-3})^3 \cdot 9{,}81 = 6\pi \eta (2 \cdot 10^{-3}) \cdot \frac{0{,}5}{17} + 1114 \cdot \frac{4}{3}\pi (2 \cdot 10^{-3})^3 \cdot 9{,}81$

$7820 \cdot \frac{4}{3}(2 \cdot 10^{-3})^2 \cdot 9{,}81 = 6\eta \cdot \frac{0{,}5}{17} + 1114 \cdot \frac{4}{3}(2 \cdot 10^{-3})^2 \cdot 9{,}81$

$0{,}40\,9142 = 0{,}17647\,\eta + 0{,}05828$

$0{,}35085752 = 0{,}176474\,\eta$

$\eta = \underline{1{,}988\ Pa\,s}$

$\nu = \frac{1{,}988}{1114} = \underline{1{,}785 \cdot 10^{-3}\ m^2\,s^{-1}}$

**p. 89** ①

CHEM. ROVNOVÁHA

$$K_p = \frac{p_r(C_4H_8)\cdot p_r^2(HI)}{p_r(C_4H_{10})\cdot p_r(I_2)} =$$

$p_r(C_4H_8) = 0{,}847/101{,}325 = 0{,}008359$

$p_r(HI) = 1{,}69/101{,}325 = 0{,}01668$

$p_r(C_4H_{10}) = 25{,}85/101{,}325 = 0{,}2551$

$p_r(I_2) = 0{,}432/101{,}325 = 0{,}004264$

$$K_p = \frac{0{,}008359\cdot 0{,}01668^2}{0{,}2551\cdot 0{,}004264} = \underline{2{,}138\cdot 10^{-3}}$$

$$K_x = \frac{x(C_4H_8)\cdot x^2(HI)}{x(C_4H_{10})\cdot x(I_2)}$$

$$x(C_4H_8) = \frac{n(C_4H_8)}{n_{celk.}}$$

$$x(C_4H_8) = \frac{p(C_4H_8)}{p_{celk}}$$

$pV = nRT$

$n = \frac{pV}{RT}$ konst.

$n \approx p$

$p_{celk} = 0{,}847 + 1{,}69 + 25{,}85 + 0{,}432$

$= 28{,}8194\,Pa$

$x(C_4H_8) = \frac{0{,}847}{28{,}819} = 0{,}02939$

$x(HI) = 0{,}05864$

$x(C_4H_{10}) = 0{,}8970$

$x(I_2) = 0{,}01499$

$$K_x = \frac{0{,}02939\cdot 0{,}05864^2}{0{,}8970\cdot 0{,}01499}$$

$$\underline{K_x = 7{,}516\cdot 10^{-3}}$$

$$K_c = \frac{c(C_4H_8)\cdot c^2(HI)}{c(C_4H_{10})\,c(I_2)}$$

$$c(C_4H_8) = \frac{n}{V} = \frac{p}{RT} = \frac{0{,}847}{8{,}314\cdot(250+273)} = \frac{0{,}847}{4348} =$$

$= 1{,}948\cdot 10^{-4}\,M$

$c(HI) = 3{,}884\cdot 10^{-4}\,M$

$c(C_4H_{10}) = 5{,}945\cdot 10^{-3}\,M$

$c(I_2) = 9{,}936\cdot 10^{-5}\,M$

$$K_c = \frac{1{,}948\cdot 10^{-4}\cdot(3{,}884\cdot 10^{-4})^2}{5{,}945\cdot 10^{-3}\cdot 9{,}936\cdot 10^{-5}} = \underline{4{,}98\cdot 10^{-5}}$$

⑦ $p(O_2) = 45{,}844\,Pa \Rightarrow p(CO_2) = 50 - 45{,}84 = 4{,}166\,Pa$

$$K_p = \frac{\left(\frac{45{,}84}{101{,}325}\right)^2}{\left(\frac{4{,}16}{101{,}325}\right)} = 4{,}985 \doteq \underline{5}$$

**p. 94** ①

FÁZOVÉ ROVNOVÁHY

CLAUSIUS–CLAPEYRON

$$\ln\frac{p_2}{p_1} = -\frac{\Delta H_{vyp}}{R}\left(\frac{1}{T_2} - \frac{1}{T_1}\right)$$

$$\ln\frac{p_2}{101325} = -\frac{40660}{8{,}314}\left(\underbrace{\frac{1}{93+273}}_{1/366} - \underbrace{\frac{1}{100+273}}_{1/373}\right)$$

$$\ln\frac{p_2}{101325} = -4890{,}5\left(\frac{1}{366} - \frac{1}{373}\right)$$

$$\ln\frac{p_2}{101325} = -0{,}25076 \Rightarrow p_2 = 78852\,Pa \doteq \underline{78{,}9\,kPa}$$

③ $\ln \frac{66,7}{53,3} = -\frac{28700}{8,314}\left(\frac{1}{T_2} - \frac{1}{24,1+273,15}\right)$

$-6,149676 \cdot 10^{-5} = \frac{1}{T_2} - 0,00336417$

$T_2 = 303,1\ K$

p. 36 ①

$p = 0,5\ MPa$

$K_H = 167\ MPa$

$c = ?$

Henryho zákon:

$x_{CO_2} = \frac{1}{K_H} \cdot p = \frac{0,5}{167} = 0,002994$

~~$x_{CO_2} =$~~ $\frac{n_{CO_2}}{n_{CO_2} + n_{H_2O}}$ $\quad c_{CO_2} = \frac{n_{CO_2}}{V}$

$n_{CO_2} \ll n_{H_2O} \Rightarrow x_{CO_2} \doteq \frac{n_{CO_2}}{n_{H_2O}} \Rightarrow n_{CO_2} \doteq x_{CO_2} \cdot n_{H_2O}$

na $1\ dm^3$: $n = \frac{m}{M} = \frac{1000}{18} = 55,5\ mol$

$V = 1\ dm^3$

$c_{CO_2} = \frac{0,002994 \cdot 55,5}{1} = 0,166\ mol/dm^3$

p. 102 ①

PÁKOVÉ PRAVIDLO


hmotnostní:

$a \cdot A = b \cdot B$

$A + B = 100$

$(0,2 - 0,05)A = (0,969 - 0,2)B$

$0,15A = 0,769B$

$0,15A = 0,769(100 - A)$

$0,15A = 76,9 - 0,769A$

$0,919A = 76,9$

$A = 83,7\ g$ anilínová

$B = 16,3\ g$ vodná

② $w_{roz} = 0,05 \Rightarrow 0,05 = \frac{m_{roz}}{m_{roz} + m_{anilín}}$

$0,05 = \frac{m_{roz}}{m_{roz} + 93,129}$ $\quad M_{anilín} = 93,129$

$\Rightarrow$ 1 mol anilínu má hmotnost $93,129\ g$

$0,05 \cdot (m_{roz} + 93,129) = m_{roz}$

$0,05\, m_{roz} + 0,05 \cdot 93,129 = m_{roz}$

$0,95\, m_{roz} = 4,656$

$m_{roz} = 4,9\ g$

KOLIGATIVNÍ VLASTNOSTI

p. 110 ① $p_B^* = 53\,330$ Pa, $t = 60{,}6$ °C

$m_x = 3{,}8$ g sloučeniny v 100 g benzenu ⇒ pokles $p$ nad roztokem

$p_B' = 51\,470$ Pa. $M_x = ?$

Raoult: $p_B = x_B \cdot p_{sol.}$ $\quad x_B + x_x = 1$

$p_B' = x_B \cdot p_B^*$

$51\,470 = x_B \cdot 53\,330 \Rightarrow x_B = 0{,}9651$

$x_B = \frac{n_B}{n_B + n_x} = 1 - x_x = 1 - \frac{n_x}{n_B + n_x}$

$0{,}9651 = 1 - \frac{m_x / M_x}{m_x/M_x + m_B/M_B}$

$0{,}9651 = 1 - \frac{3{,}8/M_x}{3{,}8/M_x + \frac{100}{6 \cdot 12 + 6 \cdot 1}}$

$\frac{3{,}8/M_x}{3{,}8/M_x + 1{,}2821} = 1 - 0{,}9651$

$\frac{3{,}8}{M_x} = 0{,}0349 \left( \frac{3{,}8}{M_x} + 1{,}2821 \right)$

$3{,}8 = 0{,}0349 (3{,}8 + 1{,}2821 M_x)$

$3{,}8 = 0{,}13262 + 0{,}04475 M_x$

$3{,}66738 = 0{,}04475 M_x \Rightarrow M_x = 81{,}95$ (?85?)

③ $M_x = \frac{K_k m_x}{-\Delta T_t m}$

$M_x = \frac{30 \cdot 0{,}010}{1{,}05 \cdot 0{,}45} = 0{,}381 \text{ kg mol}^{-1} = 381 \text{ g mol}^{-1}$

④ $M_x = \frac{K_k m_x}{-\Delta T_t m}$ $\quad 0{,}3423 = \frac{1{,}86 \cdot 0{,}0075}{-\Delta T_t \cdot 0{,}25}$

$\Delta T_t = 0{,}163$ °C

$T_t (H_2O \odot) = -0{,}163$ °C

⑤ $M_x = \frac{K_E m_x}{\Delta T_v m}$

$M_x = \frac{2{,}35 \cdot 0{,}3572 \cdot 10^{-3}}{0{,}4 \cdot 16{,}87 \cdot 10^{-3}} = 0{,}1244 \text{ kg mol}^{-1}$

$= 124{,}4 \text{ g mol}^{-1}$

$A_r(P) = 30{,}97 \Rightarrow N = \frac{124{,}4}{30{,}97} = 4{,}02 \doteq 4 \Rightarrow P_4$

⑥ $\Pi = RTc$ $\quad 120 \cdot 10^3 = 8{,}314 \cdot 300 \cdot c$

$c = 48{,}11 \text{ mol m}^{-3} = 0{,}04811 \text{ mol dm}^{-3}$

$c_{m_x} = \frac{n_x}{m} = \frac{0{,}04811}{1} = c$ $\quad m_\odot \doteq m$

$\Delta T_t = -K_k c = -1{,}86 \cdot 0{,}04811 = -0{,}08949$ °C

$\doteq -0{,}09$ °C

## 2. 119 — ADSORPCE

① $\Gamma_{max} = 110\ cm^3$

$\omega = 7{,}5 \cdot 10^{-6}\ Pa^{-1}$

$$\Gamma\ (cm^3) = \frac{\Gamma_{max}\ \omega p}{1 + \omega p}$$

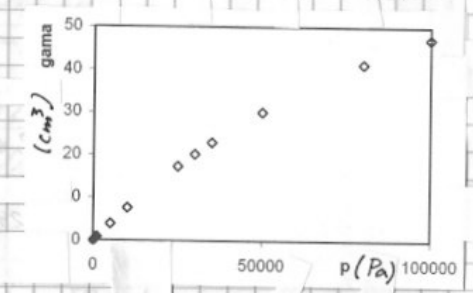
$$V = 110 \cdot \frac{7{,}5 \cdot 10^{-6} p}{1 + 7{,}5 \cdot 10^{-6} p}$$

| p (Pa) | $\Gamma$ (Excel) ($cm^3$) |
|---|---|
| 100 | 0,0824 |
| 500 | 0,411 |
| 1000 | 0,819 |
| 5000 | 3,976 |
| 10 000 | 7,674 |
| 50 000 | 30 |
| 100 000 | 47,14 |

Excel:

25 kPa = 25 000 Pa $\Rightarrow \Gamma = 17{,}37\ cm^3$

50 kPa = 50 000 Pa $\Rightarrow \Gamma = 30\ cm^3$




b) $\Gamma = \frac{\Gamma_{max} \cdot 0{,}85p}{1 + 0{,}85p} \Rightarrow \frac{\Gamma}{\Gamma_{max}} = \frac{0{,}85p}{1 + 0{,}85p}$

a) $\frac{\Gamma}{\Gamma_{max}} = 0{,}15 \Rightarrow 0{,}15 = \frac{0{,}85p}{1 + 0{,}85p} \Rightarrow 0{,}15(1 + 0{,}85p) = 0{,}85p$

$0{,}15 + 0{,}15 \cdot 0{,}85p = 0{,}85p$

$p = 0{,}21\ kPa$

b) $\frac{\Gamma}{\Gamma_{max}} = 0{,}95 \Rightarrow 0{,}95 = \frac{0{,}85p}{1 + 0{,}85p} \Rightarrow 0{,}95(1 + 0{,}85p) = 0{,}85p$

$0{,}95 = 0{,}05 \cdot 0{,}85p$

$p = 22{,}4\ kPa$

## s. 52–53: TERMODYNAMIKA — $Q = n \cdot C_m \cdot \Delta T$

② a) $V = konst.$

$U = Q + W$

$C_{mp} - C_{mv} = R$

$V = konst \Rightarrow W = 0$

$\frac{C_{mp}}{C_{mv}} = \kappa$ ; 2-at. plyn $\Rightarrow \kappa = 1{,}4$

$C_{mp} = 1{,}4 \cdot C_{mv}$

$1{,}4\ C_{mv} - C_{mv} = 8{,}314 \Rightarrow C_{mv} = \frac{8{,}314}{0{,}4} = 20{,}785\ J K^{-1} mol^{-1}$

$C_{mp} = 29{,}099\ J K^{-1} mol^{-1}$

$Q_{mv} = C_{mv} \cdot \Delta T = 20{,}875 \cdot 100 = 2087{,}5\ J$ na 1 mol

$n = \frac{m}{M} = \frac{150}{32} = 4{,}69\ mol$

$Q_v = n \cdot Q_{mv} = 4{,}69 \cdot 2087{,}5 = 9785\ J \doteq 9{,}8\ kJ$

9790 J

b) $Q_p = n \cdot C_{mp} \cdot \Delta T = 4{,}69 \cdot 29{,}099 \cdot 100 = 13647\ J$

$= 13{,}6\ kJ$

⑦ Fe, $m = 400\ kg$ $\quad C_{Fe} = 0{,}465\ kJ\,K^{-1}kg^{-1}$

$H_2O$, $m = 500\ kg$ $\quad C_{H_2O} = 4{,}192\ kJ\,K^{-1}kg^{-1}$

$15°C \rightarrow 100°C$

$Q = ?$

$$Q = Q_{Fe} + Q_{H_2O} = C_{Fe}\, m_{Fe} \cdot \Delta T + C_{H_2O}\, m_{H_2O}\, \Delta T$$

$$Q = 0{,}465 \cdot 400 \cdot (100-15) + 4{,}192 \cdot 500 \cdot (100-15) =$$

$$= 15\,810 + 178\,160 = 193\,970\ kJ \doteq \underline{194\ MJ}$$

⑧ ~~Cp~~ ⓐ $H_2$ ⓑ $N_2$ ⓒ $O_2$

$C_V = C_p - R$

| | ⓐ $H_2$ | ⓑ $N_2$ | ⓒ $O_2$ |
|---|---|---|---|
| $C_p$ | $28{,}824\ JK^{-1}mol^{-1}$ | $29{,}125\ JK^{-1}mol^{-1}$ | $29{,}355\ JK^{-1}mol^{-1}$ |
| $C_V$ = | $20{,}510$ " | $20{,}811$ " | $21{,}041$ " |
| $C_p$ = | $\frac{28{,}824}{2} \cdot 1000 = 14412\ JK^{-1}kg^{-1}$ | $\frac{29{,}125}{28} \cdot 1000 = 1040\ JK^{-1}kg^{-1}$ | $\frac{29{,}355}{32} \cdot 1000 = 917\ JK^{-1}kg^{-1}$ |
| $C_V$ = | $\frac{20{,}510}{2} \cdot 1000 = 10255$ | $\frac{20{,}811}{28} \cdot 1000 = 743$ " | $\frac{21{,}041}{32} \cdot 1000 = 657$ " |

⑨ $Q_1 = Q_2$

$m_1 C \Delta T_1 = m_2 C \Delta T_2$

$10 \cdot C \cdot (65-50) = m_2 C (50-15)$

$10 \cdot 15 = m_2 \cdot 35 \Rightarrow \underline{4{,}29\ dm^3\ (kg)}$

⑩ $Q_{přijaté\ vodou} = Q_{odevzdané\ platinou}$

$$m_{H_2O} \cdot C_{H_2O} \cdot (18{,}25-18) = m_{Pt} \cdot C_{Pt} \cdot (153-18{,}25)$$

$$0{,}2 \cdot 4187 \cdot 0{,}25 = 0{,}01186 \cdot C_{Pt} \cdot 134{,}75$$

$$C_{Pt} = 130{,}996\ JK^{-1}kg^{-1}$$

$$\doteq \underline{131\ JK^{-1}kg^{-1}}$$

s. 64 | ~~TERMOCHEMIE~~ | TERMODYNAMIKA II

④ $\Delta G = \Delta H - T\Delta S$

$\Delta G_{300} = 95000 - 300 \cdot 180 = \underline{+41\,000\ J\,mol^{-1}}$ ne

$\Delta G_{900} = 95000 - 900 \cdot 180 = \underline{-67000\ J\,mol^{-1}}$ ano

~~⑨~~ ~~$U = W + Q$, $T = konst.$~~ ⑩

$$\Delta S = n \cdot C_V \cdot \ln \frac{T_2}{T_1} = \frac{80}{28} \cdot (29{,}125 - 8{,}314) \cdot \ln \frac{400}{300}$$

$$= 2{,}86 \cdot 20{,}811 \cdot 0{,}288 = \underline{17{,}14\ JK^{-1}}$$

⑧ 10g ledu, 0°C
30g $H_2O$, 90°C

a) $\Delta H_{tání} = 5\,980\ J\,mol^{-1}$

$n_{led} = \frac{10}{18} = 0{,}555\ mol$

$n_{kap.} = \frac{30}{18} = 1{,}666\ mol$

$C_{H_2O} = 4{,}192\ kJ\,K^{-1}kg^{-1}$ → kapalná

$Q_{přijaté\ ledem} = Q_{odevzdané\ vodou}$

⑩

$0{,}555 \cdot 5980 + 10 \cdot 10^{-3} \cdot 4192 \cdot (T-0) =$

$= 0{,}03 \cdot 4192 \cdot (90-T)$

$3318{,}9 + 41{,}92T = 125{,}76T + 11318{,}4$

$7999{,}9 = 167{,}68T$

$T = 47{,}7°C$

**ú. 70**

$Fe_2O_3 + 2Al \rightarrow Al_2O_3 + 2Fe$

① (produkty)

$-(-824{,}2 + 0) + (-1675{,}7 + 2 \cdot 0) = -851{,}5$ kJ/mol

$-851{,}5$ kJ ... 111,7 g Fe
$x$ kJ ... 1000 g Fe

$x = 53304$ J $\doteq 53{,}3$ MJ (o 3 řády vedle)

② $CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$

$\Delta H_{spal} = -891$ kJ/mol (štěpení)

1 mol $CH_4$ ... $-891$ kJ ... 22,4 dm³
$x$ ... 500 dm³

$x = 19\,888$ kJ $= 19{,}9$ MJ uvolní

$\Delta H = -19{,}9$ MJ

③ $n = \frac{m}{M} = \frac{1{,}1050}{128{,}18} = 0{,}00862069$ mol

$Q = C \cdot \Delta T = 19670 \cdot (22{,}26 - 20) = 44454{,}2$ J

0,00862069 mol ... 44454,2 J
1 mol ... $x$

$x = 5\,156\,687$ J/mol $\doteq 5{,}2$ MJ/mol

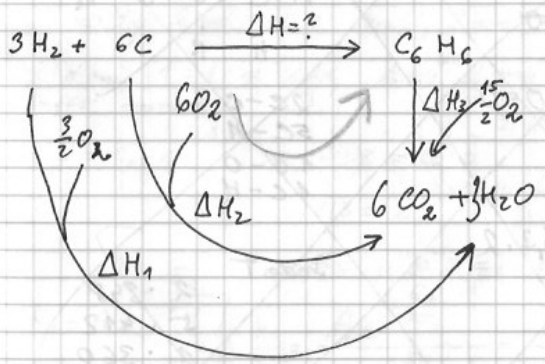
④ ne

⑤a $CO_2 + H_2 \rightarrow CO + H_2O$ (produkty)

$-(-393{,}51) + (-110{,}53 - 241{,}82) =$

$= 41{,}16$ kJ/mol

⑥




$\Delta H = \Delta H_1 + \Delta H_2 - \Delta H_3$

$\Delta H = 3 \cdot (-286) + 6 \cdot (-394) - 1 \cdot (-3268)$

$\Delta H = +46$ kJ/mol

(7) a) $\Delta H_r = \Delta H_{spal\,v\check{s}ch} - \Delta H_{spal,prod}$ kJ/mol

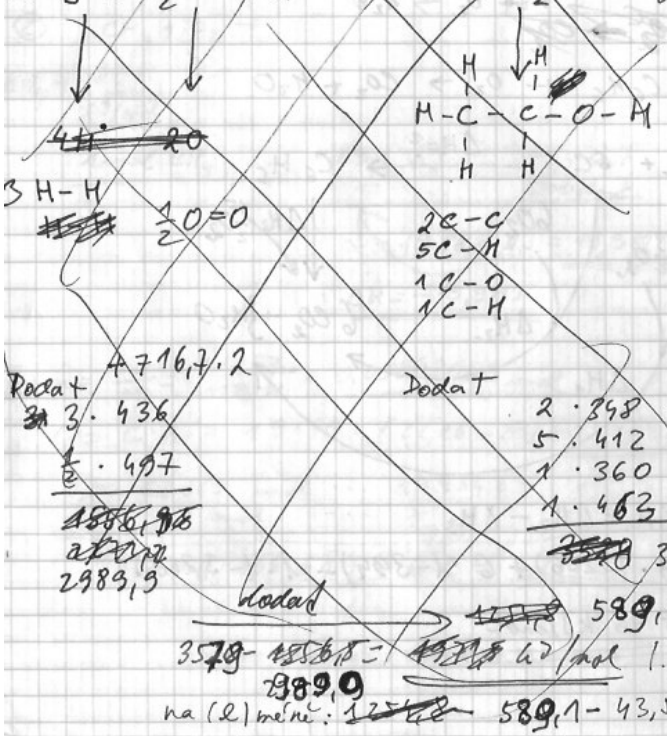
a) $\Delta H_r = (-283 + 3\cdot(-286)) - (-891 + 0) = -250$

b) $\Delta H_r = (0 + (-286)) - (-283 + 0) = -3$ kJ/mol

c) $\Delta H_r = (0 + 2\cdot(-286)) - (-394 + 2\cdot 0) = -178$ kJ/mol

d) $\Delta H_r = (0 + 4\cdot(-286)) - (-891 + 2\cdot 0) = -253$ kJ/mol

(8) $3H_2 + \frac{1}{2}O_2 + 2C \rightarrow CH_3CH_2OH\,(g)$




1.48: $N = N_0 e^{-\lambda t}$ $\lambda = \frac{\ln 2}{\tau}$

(1) $N = N_0 e^{-\frac{1}{\tau}\ln 2 \cdot t}$

$\frac{N}{N_0} = \frac{I}{I_0} = 0{,}562 = e^{-\frac{\ln 2}{5730}\cdot t}$

$t = 4764$ let

(2) $\lambda = \frac{\ln 2}{\tau} \Rightarrow \tau = \frac{\ln 2}{\lambda} = \frac{\ln 2}{5{,}46\cdot 10^{-4}}\,s = 1269{,}5\,s =$

$= 21{,}2$ min

(3) $\square \rightarrow 2 =$

1 : 1 $\Rightarrow$ z pův. 3 mol $\square$ zreagoval 1 mol

$\Rightarrow$ Zbyly 2 mol $\square$ a vznikly 2 mol $=$.

$\Rightarrow$ Poměr 1 : 1 je zhruba, když zbývají 2/3 původního množství $\square$.

$c = c_0 e^{-kt}$ $\Rightarrow$ $2/3\,c_0 = c_0 e^{-2{,}48\cdot 10^{-4} t}$

$2/3 = e^{-2{,}48\cdot 10^{-4} t}$

$t = 1635\,s = 27{,}25$ min

(5) $K_1 = A e^{-\frac{E_A}{RT_1}}$, $K_2 = A e^{-\frac{E_A}{RT_2}}$

$\frac{K_1}{K_2} = \frac{A e^{-\frac{E_A}{RT_1}}}{A e^{-\frac{E_A}{RT_2}}} = \frac{e^{-\frac{E_A}{RT_1}}}{e^{-\frac{E_A}{RT_2}}} =$

$\frac{3{,}517\cdot 10^{-7}}{3{,}954\cdot 10^{-2}} = e^{-\frac{E_A}{8{,}314}\left(\frac{1}{536} - \frac{1}{781}\right)} = e^{-\frac{E_A}{R}\left(\frac{1}{T_1} - \frac{1}{T_2}\right)}$

$8{,}895\cdot 10^{-6} = e^{-0{,}000062322\,E_A}$

$\Rightarrow -11{,}63 = -0{,}000062322\,E_A$

$E_A = 186\,612$ J mol$^{-1}$

Str. 168] úlohy str. 153:

① $\mu(H_2O) = \sqrt{2\mu_{OH}^2 + 2\mu_{OH}^2 \cos\alpha} = \sqrt{2\mu_{OH}^2(1+\cos\alpha)}$

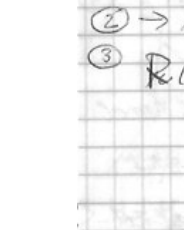
$6{,}17 \cdot 10^{-30} = \sqrt{2 \cdot (5{,}27 \cdot 10^{-30})^2 (1+\cos\alpha)}$ /²

$(6{,}17 \cdot 10^{-30})^2 = 2 \cdot (5{,}27 \cdot 10^{-30})^2 (1+\cos\alpha)$

$6{,}17^2 = 2 \cdot 5{,}27^2 (1+\cos\alpha) \Rightarrow$ ~~$\alpha = 120°$~~

$\alpha = 108{,}34°$

② → netřeba

③ $R(EtOH) =$  $= 5 \cdot R(C-H) + R(C-C) + R(C-O) + R(O-H) =$

| | | |
|---|---|---|
| 5 × C–H | 1 × C–O | $= 5 \cdot 1{,}65 + 1{,}2 + 1{,}41 + 1{,}66$ |
| 1 × C–C | 1 × O–H | $= 12{,}52\ cm^3\ mol^{-1}$ |

$R(EtOH) = \frac{n^2-1}{n^2+2} \cdot \frac{M}{\rho} = 12{,}52$

$\frac{n^2-1}{n^2+2} \cdot \frac{46{,}068}{0{,}789} = 12{,}52$

$\frac{n^2-1}{n^2+2} = 0{,}2144$

$n^2 - 1 = 0{,}2144(n^2+2)$

$n^2 - 1 = 0{,}2144\,n^2 + 0{,}4288$

$n^2 \cdot 0{,}7856 = 1{,}4288$

$n^2 = 1{,}8187 \Rightarrow n = 1{,}3486$

④ $E = h \cdot \frac{c}{\lambda}$, $h = 6{,}626 \cdot 10^{-34}\ J\,s$

$\nu = \frac{c}{\lambda}$ $\quad c = 3 \cdot 10^8\ m\,s^{-1}$

a) $\nu = \frac{3 \cdot 10^8}{690 \cdot 10^{-9}} = 4{,}348 \cdot 10^{14}\ s^{-1}$

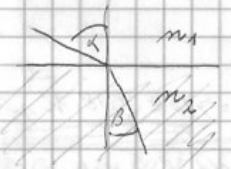
b) vlnočet $= \frac{1}{\lambda} = \frac{1}{690 \cdot 10^{-9}} = 1{,}449 \cdot 10^6\ m^{-1}$

c) $E = h \cdot \frac{c}{\lambda} = 6{,}626 \cdot 10^{-34} \cdot \frac{3 \cdot 10^8}{690 \cdot 10^{-9}}$

$= 2{,}881 \cdot 10^{-19}\ J = 1{,}798\ eV$

$1\ eV = 1{,}602 \cdot 10^{-19}\ J$

⑤ $n = \frac{c}{v}$ a) $1{,}54997 = \frac{3 \cdot 10^8}{v} \Rightarrow v = 1{,}936 \cdot 10^8\ m\,s^{-1}$

b) 


Myšleno při zaprášek dopadá ze vzduchu ($n_1 = 1$) do nitrobenzenu ($n_2 = 1{,}54997$).

Snellův zákon:

$\frac{n_1}{n_2} = \frac{\sin\beta}{\sin\alpha} \parallel \frac{1}{1{,}54997} = \frac{\sin\beta}{\sin 45°}$

$\sin\beta = 0{,}4562 \Rightarrow \beta = 27{,}14°$

c) $\frac{n_1}{n_2} = \frac{\sin\beta}{\sin\alpha} \parallel \frac{1}{1{,}54997} = \frac{\sin 30°}{\sin\alpha} \Rightarrow \alpha = 50{,}48°$

⑥ $\alpha = [\alpha] \cdot c \cdot l$

$5 = 66{,}57 \cdot c \cdot 2 \Rightarrow c = 0{,}03755\ kg\ dm^{-3} =$

$= 37{,}55\ g\ dm^{-3}$

Latterová buňka:

$c_n = \frac{n}{V} = \frac{m}{MV} = \frac{c}{M} = \frac{37{,}55\ g\ dm^{-3}}{342{,}3\ g\ mol^{-1}} =$

$= \frac{37{,}55}{342{,}3}\ mol\ dm^{-3} = 0{,}1097\ mol\ dm^{-3}$

⑦ $\alpha = [\alpha]\, c\, l$ $\quad c \cdot 1000 =$ počet gramů / 1000 ml

$\alpha = [\alpha] \cdot \frac{\alpha}{100} \cdot l$ $\quad c \cdot 100 =$ počet gramů / 100 ml

$1 = 52{,}8 \cdot \frac{l}{100}$ $\quad c = \frac{\text{počet gramů / 100 ml}}{100} = \frac{\alpha}{100}$

$l = 1{,}89\ dm = 18{,}9\ cm = 189\ mm$

⑧ $A = \varepsilon l c \Rightarrow 0{,}5 = 2400 \cdot 1 \cdot c \Rightarrow c = 2{,}08 \cdot 10^{-4}\ mol\ dm^{-3}$

Pozn.: Jednotky u vztahu $\alpha = [\alpha] c\, l$, usp. $A = \varepsilon l c$ vznikly historicky, neodpovídají základním rozměrům SI a je nutno je nutně znát zpaměti.

⑨ a) $T = \frac{I}{I_0} = \frac{70}{100} = 0{,}7$ $\quad$ b) $A = -\log T$

$= -\log 0{,}7 = 0{,}155$

10 – nevím

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str. 124 ① $K_s = [Ag^+][Cl^-]$ $\quad AgCl \rightarrow Ag^+ + Cl^-$

$[Ag^+] = [Cl^-] = c(AgCl)$

$K_s = [Ag^+]^2$

$K_s = (1{,}08 \cdot 10^{-5})^2 = 1{,}17 \cdot 10^{-10}$

$c = \frac{n}{V} = \frac{m}{MV} = \frac{c_m}{M}$

$c = \frac{1{,}55 \cdot 10^{-2}}{(107{,}87 + 35{,}45)} =$

$= 1{,}08 \cdot 10^{-5} M = [Ag^+] = [Cl^-]$

② $TlBr \rightarrow Tl^+ + Br^-$

$[Tl^+] = [Br^-]$

$K_s = [Tl^+][Br^-] = [Br^-]^2$

$K_s = (1{,}84 \cdot 10^{-3})^2 = 3{,}386 \cdot 10^{-6}$

$pK_s = -\log K_s = 5{,}47$

④ $AgI \rightarrow Ag^+ + I^-$ $\quad K_s = [Ag^+][I^-] = [Ag^+]^2$

nebylo za úkol $\quad K_s = (1{,}026 \cdot 10^{-8})^2 = 1{,}053 \cdot 10^{-16}$

$pK_s = -\log K_s = 16{,}00$

③ $BaSO_4 \rightarrow Ba^{2+} + SO_4^{2-}$ $\quad pK_s = 9{,}96$

$K_s = [Ba^{2+}][SO_4^{2-}]$ $\quad K_s = 10^{-9{,}96} = 1{,}096 \cdot 10^{-10}$

$1{,}096 \cdot 10^{-10} = [Ba^{2+}] \cdot 0{,}01$

$[Ba^{2+}] = 1{,}096 \cdot 10^{-8}\ mol\ dm^{-3}$

⑤ Počítáme bez alkalit

$K_s = [Ba^{2+}][SO_4^{2-}]$

$1{,}096 \cdot 10^{-10} = [Ba^{2+}][SO_4^{2-}]$ (viz příl. 3)

a) $1{,}096 \cdot 10^{-10} = [Ba^{2+}]^2 \Rightarrow [Ba^{2+}] = 1{,}047 \cdot 10^{-5}\ mol\,dm^{-3}$

b) v KCl – nejsou společné ionty ⇒ rozpustí jako v $H_2O$

d) v $Zn(NO_3)_2$ — " —

$1{,}047 \cdot 10^{-5}\ mol\,dm^{-3}$

c) $1{,}096 \cdot 10^{-10} = 0{,}001 \cdot [SO_4^{2-}]$

$[SO_4^{2-}] = 1{,}096 \cdot 10^{-7}\ mol\,dm^{-3}$

126/1. ① a)

| | $[H_3O^+]$ | $[OH^-]$ | pH | pOH |
|---|---|---|---|---|
| a) | 0,001 | | 3 | 11 |
| b) | $1{,}8 \cdot 10^{-4}$ | | 3,74 | 10,26 |
| c) | $6{,}8 \cdot 10^{-9}$ | | 8,17 | 5,83 |
| d) | | 0,01 | 12 | 2 |
| e) | | $4{,}25 \cdot 10^{-3}$ | 11,63 | 2,37 |
| f) | | $6 \cdot 10^{-10}$ | 4,78 | 9,22 |

②

| | pH | pOH | $[H_3O^+]$ | $[OH^-]$ |
|---|---|---|---|---|
| a) | 1 | | $10^{-1} = 0{,}1$ | $14-1=13 \Rightarrow 10^{-13}$ |
| b) | 8,9 | | $10^{-8,9} = 1{,}26 \cdot 10^{-9}$ | $5{,}1 \Rightarrow 10^{-5,1} = 4{,}94 \cdot 10^{-6}$ |
| c) | 12 | | $10^{-12}$ | $10^{-2}$ |
| d) | | 1 | $10^{-13}$ | 0,1 |
| e) | | 7,5 | $3{,}16 \cdot 10^{-7}$ | $3{,}16 \cdot 10^{-8}$ |
| f) | | 3,3 | $2 \cdot 10^{-11}$ | $5{,}01 \cdot 10^{-4}$ |

A. 128 ① HCl – silná kyselina, jednosytná

$[H^+] = c(HCl)$

a) $pH = -\log(3 \cdot 10^{-2}) = 2{,}52$

b) $pH = -\log 10^{-5} = 5$

c) $c = \frac{n}{V} = \frac{m}{MV} = \frac{c_M}{M} = \frac{3 \cdot 10^{-3}}{(1+35{,}5)} = 8{,}22 \cdot 10^{-5}\ mol\,dm^{-3}$

$pH = 4{,}09$

d) $c = \frac{10^{-5}}{36{,}5} = 2{,}74 \cdot 10^{-7} \Rightarrow pH = 6{,}56$

② ~~Ka~~ silná HI

a) $[H^+] = 10^{-2} \Rightarrow c(HI) = 0{,}01\ mol\,dm^{-3}$

b) $[H^+] = 10^{-3{,}15} \Rightarrow c(HI) = 7{,}08 \cdot 10^{-4}\ mol\,dm^{-3}$

c) $[H^+] = 10^{-4{,}4} = c(HI) = 3{,}98 \cdot 10^{-5}\ mol\,dm^{-3}$

③ a) $HCOOH$ $pK = 3{,}75$ $[H^+] = \sqrt{K_a \cdot c}$

$[H^+] = \sqrt{10^{-3{,}75} \cdot 0{,}02} = 0{,}00188$

$pH = 2{,}72$

b) $[H^+] = \sqrt{10^{-4{,}75} \cdot 0{,}02} = 5{,}96 \cdot 10^{-4}$ $pH = 3{,}22$

c) $[H^+] = \sqrt{10^{-2{,}12} \cdot 0{,}02} = 0{,}0123$ $pH = 1{,}91$

d) $[H^+] = 0{,}02 \Rightarrow pH = 1{,}70$

e) $[H^+] = 2 \cdot 0{,}02 = 0{,}04$ $pH = 1{,}40$

3,23
2,04
1,70
1,40
1,76
5.

④ $[H^+] = 10^{-pH} = 10^{-3}$

$[H^+] = \sqrt{K_a \cdot c}$

$10^{-3} = \sqrt{K_a \cdot 1{,}058 \cdot 10^{-3}}$

$K_a = 0{,}000945$ | $pK_a = 3{,}024$

⑤ $[H^+] = 0{,}0315\ g\ dm^{-3}$

$M(HNO_3) = 1 + 14 + 3 \cdot 16 = 63\ g\ mol^{-1}$

1 mol ..... 63 g

x mol ..... 0,0315

$x = 0{,}0005\ mol$

$[H^+] = 0{,}0005\ mol\ dm^{-3}$

a) $c(HCl) = c(HNO_3) = 0{,}0005\ mol\ dm^{-3}$

b) $[H^+] = \sqrt{K_a \cdot c}$

$0{,}0005 = \sqrt{10^{-3{,}75} \cdot c} \Rightarrow c = 0{,}014\ mol\ dm^{-3}$

c) $0{,}0005 = \sqrt{10^{-3{,}75} c} \Rightarrow c = 0{,}0014\ mol\ dm^{-3}$

p. 130

a) $pOH = -\log(3 \cdot 10^{-3}) = 2{,}52$ $pH = 11{,}48$ (= 14 − 2

① b) $pOH = 5 \Rightarrow pH = 9$

c) $M(NaOH) = 23 + 16 + 1 = 40$

1 mol ..... 40 g

x mol ..... $3 \cdot 10^{-3}$ g

$x = 0{,}000075\ mol \Rightarrow [OH^-] = 0{,}000075\ mol$

$pOH = 4{,}12 \Rightarrow pH = 9{,}88$

d) 1 mol ..... 40 g

x mol ..... $10^{-5}$ g

$x = 2{,}5 \cdot 10^{-7}\ mol \Rightarrow [OH^-] = 2{,}5 \cdot 10^{-7}\ mol\ dm^{-3}$

$pOH = 6{,}6 \Rightarrow pH = 7{,}4$

② a) $pH = 12 \Rightarrow pOH = 14 - 12 = 2 \Rightarrow [OH^-] = 10^{-2}\ mol\ dm^{-3}$

b) $pH = 13{,}11 \Rightarrow pOH = 14 - 13{,}11 = 0{,}89 \Rightarrow [OH^-] = 0{,}129\ mol\ dm^{-3}$

c) $pH = 10{,}4 \Rightarrow pOH = 14 - 10{,}4 = 3{,}6 \Rightarrow [OH^-] = 10^{-3{,}6} = 2{,}51 \cdot 10^{-4}\ mol\ dm^{-3}$

③ $[OH^-] = \sqrt{K_b \cdot c}$ a) $[OH^-] = \sqrt{10^{-8{,}75} \cdot 0{,}02} = 5{,}96 \cdot 10^{-6}$ $pOH = 5{,}22$ $pH = 8$

b) $[OH^-] = \sqrt{10^{-4{,}75} \cdot 0{,}02} = 5{,}96 \cdot 10^{-4}$ $pOH = 3{,}22$ $pH = 10{,}78$

c) $[OH^-] = \sqrt{10^{-3{,}19} \cdot 0{,}02} = 0{,}0035$ $pOH = 2{,}44$ $pH = 11{,}56$

d) $pOH = -\log 0{,}02 = 1{,}70$ $pH = 12{,}3$

④ $pOH = 14 - pH = 14 - 11,5 = 2,5$

$[OH^-] = \sqrt{K_b \cdot c}$ $\quad 10^{-2,5} = \sqrt{K_b \cdot 8,53 \cdot 10^{-3}} \Rightarrow K_b = 1,17 \cdot 10^{-3}$

$pK_b = 2,93$

⑤ $cNH_3 = 0,0017\ g\,dm^{-3}$, $pH = ?$

1 mol $NH_3$ .... $14+3 = 17\,g$

x mol .... $0,0017\,g$

$x = 0,0001\ mol$

$[OH^-] = \sqrt{K_b \cdot c}$ $\quad [OH^-] = \sqrt{10^{-4,75} \cdot 0,0001}$

$[OH^-] = 4,22 \cdot 10^{-5}\ mol\,dm^{-3}$

135 ① Henderson - Hasselbach:

$[H^+] = K_a \frac{c_{kys}}{c_{sůl}}$

$[H^+] = 10^{-4,75} \frac{0,1}{0,1} = 10^{-4,75} \Rightarrow pH = pK_a = 4,75$

② $CH_3COOH + NaOH \rightarrow CH_3COONa + H_2O$

$n_{CH_3COOH\ původní} = c \cdot V = 0,1 \cdot 1 = 0,1\ mol = n_{CH_3COOH}$

$n_{NaOH\ přidaného} = \frac{m}{M} = \frac{1\,g}{23+16+1} = \frac{1}{40} = 0,025\ mol$

$n_{CH_3COOH\ zbylé} = 0,1 - 0,025 = 0,075\ mol$

$n_{CH_3COONa\ vzniklé} = 0,1 + 0,025 = 0,125\ mol$

$[H^+] = 10^{-4,75} \cdot \frac{0,075}{0,125} = 1,067 \cdot 10^{-5}$, $pH = 4,97$

$\Delta pH = 0,22$

přidáním NaOH do roztoku:

$[OH^-] = \frac{n}{V} = \frac{0,025\ mol\ NaOH}{1001\ dm^3} = 0,025\ mol\,dm^{-3}$

$pOH = 1,6$, $pH = 12,4$

$\Delta pH = 12,4 - 7 = 5,4$

③ Alkal., Henderson - Hasselbach: ↳ číselně nevyšlo

$[OH^-] = 10^{-K_b} \cdot \frac{c_{zás}}{c_{sůl}}$

$K_b = 10^{-4,75}$

a) $[OH^-] = 10^{-4,75} \cdot \frac{0,1}{0,1^2} = 2,89 \cdot 10^{-6}$ $\quad pOH = 5,05$ ✓ $pH = 8,95$

d) + 0,001 mol HI

$[OH^-] = 10^{-4,75} \cdot \frac{0,1 - 0,001}{0,1 + 0,001} = 8,75 \cdot 10^{-6}$ $\quad pOH = 5,06$ $\quad pH = 8,94$

e) $[OH^-] = 10^{-4,75} \frac{0,1 - 0,01}{0,1 + 0,01} = 7,62 \cdot 10^{-6}$ $\quad pOH = 5,12$ $\quad pH = 8,88$

f) $[OH^-] = 10^{-4,75} \frac{0,1 + 0,001}{0,1 - 0,001} = 9,03 \cdot 10^{-6}$ $\quad pOH = 5,04$ $\quad pH = 8,96$

d) $[OH^-] = 10^{-4,75} \frac{0,1 + 0,01}{0,1 - 0,01} = 1,03 \cdot 10^{-5}$ $\quad pOH = 4,99$ $\quad pH = 9,01$

138]

a) $\varkappa = C \cdot G \Rightarrow C = \frac{\varkappa}{G}$

①

$C = \frac{1{,}4127 \cdot 10^{-3}\ S\,cm^{-1}}{25{,}8 \cdot 10^{-3}\ S} = 0{,}0548\ cm^{-1}$

b) $\frac{\varkappa_1}{G_1} = \frac{\varkappa_2}{G_2} \Rightarrow 0{,}0548 = \frac{\varkappa_2}{450 \cdot 10^{-6}}$

($C$)

$\varkappa_2 = 0{,}0548 \cdot 450 \cdot 10^{-6}$

$= 2{,}466 \cdot 10^{-5}\ S\,cm^{-1}$

$= 2{,}466 \cdot 10^{-2}\ mS\,cm^{-1}$

$= 2{,}466\ mS\,m^{-1}$

②

Ostwaldův zákon:

zruší se $K_a = \frac{\alpha^2 c}{1 - (\alpha_0 + \alpha_c)}$

$\alpha = \alpha_0 \times$

$8{,}29 = 392 \cdot \times$

$\times = 0{,}0211$

$C = \frac{\varkappa}{G}$

$3{,}61 = \frac{\varkappa}{21{,}82 \cdot 10^{-3}} \Rightarrow \varkappa = 82{,}88\ S\,m^{-1}$

$\alpha = \frac{\varkappa}{C} = \frac{82{,}88\ S\,m^{-1}}{0{,}01 \cdot 10^{3}\ mol\,m^{-3}} = 8{,}29\ S\,mol^{-1}\,m^{2}$

$K_a = \frac{8{,}29^2 \cdot 0{,}01}{8{,}29\,((\ldots) - 8{,}29)} = 2{,}160 \cdot 10^{-4}$

$pK_a = 3{,}66$

392

$42{,}2 + 349{,}8$

146]

① $E = E^\circ + \frac{RT}{kF} \ln a$

a) $E_p = E^\circ_{(Ag^+/Ag)} + \frac{RT}{kF} \ln a_p \qquad E_L = E^\circ_{(Ag^+/Ag)} + \frac{RT}{kF} \ln a_L$

$\Delta E = E_p - E_L = \frac{RT}{kF}(\ln a_p - \ln a_L) = \frac{RT}{kF} \ln \frac{a_p}{a_L}$

$\Delta E = \frac{8{,}314 \cdot 298{,}15}{1 \cdot 96500} \ln \frac{0{,}1}{0{,}001} = 0{,}1183\ V$

b) totéž $\Rightarrow \Delta E = 0{,}1183\ V$

② $E_p = E^\circ_{(Cl/Cl^-)} + \frac{RT}{2F} \ln a$ — nevychází

$E_L = E^\circ_{(H^+/H)} + \frac{RT}{1 \cdot F} \ln a$

$\Delta E = E^\circ_{(Cl/Cl^-)} - E^\circ_{(H^+/H)} = 1{,}3595\ V \qquad (?\ 1{,}536\ ?)$ ?

③ $E = E^\circ_{(Ag^+/Ag)} + \frac{RT}{F} \ln a_{Ag^+} = 0{,}7991 + \frac{8{,}314 \cdot 298{,}15}{96500} \ln 0{,}05$

(a)

$= 0{,}7991 - 0{,}0769 = 0{,}7221\ V$

(b) $AgCl \rightarrow Ag^+ + Cl^-, \quad K_s = [Ag^+][Cl^-] = 10^{-9{,}75}$

$[Ag^+] = [Cl^-] \Rightarrow [Ag^+]^2 = 10^{-9{,}75}$

$[Ag^+] = 1{,}334 \cdot 10^{-5}$

$E = 0{,}7991 + \frac{8{,}314 \cdot 298{,}15}{96500} \ln(1{,}334 \cdot 10^{-5}) =$

$= 0{,}511\ V$

c) z asi půlky ~~$[Cl^-] = 4{,}15$~~

~~$[Cl^-] = 10^{-9{,}75} = 1{,}78 \cdot 10^{-5}$~~

~~$E = 0{,}7991 + \frac{8{,}314 \cdot 298{,}15}{96500} \ln 1{,}78 \cdot 10^{-5}$~~

$[Ag^+][Cl^-] = 10^{-9{,}75}$

$[Ag^+] \cdot 4{,}15 = 10^{-9{,}75}$

$[Ag^+] = 4{,}285 \cdot 10^{-11}$

$E = 0{,}7991 + \frac{8{,}314 \cdot 298{,}15}{96500} \ln (4{,}285 \cdot 10^{-11}) = 0{,}186\ V$

d) $E = 0 - \frac{RT}{2F} \ln \frac{a_{H_2}}{a^2_{H^+}} = -\frac{8{,}314 \cdot 298{,}15}{2 \cdot 96500} \ln \frac{\frac{150}{100}}{(10^{-5{,}45})^2} =$

$= 0{,}01284 \ln \frac{1{,}5}{1{,}259 \cdot 10^{-11}} = \sim\sim 0{,}0128 \cdot 4 \sim\sim V$

$= -0{,}327\ V$

e) $[CH_3COOH] = 0{,}1$

$\Rightarrow [H^+] = \sqrt{K_a \cdot c} = \sqrt{10^{-4{,}75} \cdot 0{,}1} = 0{,}001334\ M$

$E = 0 - \frac{RT}{2F} \ln \frac{a_{H_2}}{a^2_{H^+}} = -\frac{8{,}314 \cdot 298{,}15}{2 \cdot 96500} \ln \frac{1}{0{,}001334} =$

$= -0{,}085\ V$ – nejsilo podle výsledku

f) $E = E^\circ + \frac{RT}{kF} \ln \frac{a_{ox}}{a_{red}} = 0{,}771 + \frac{8{,}314 \cdot 298{,}15}{96500} \ln \frac{0{,}4}{Fe^{3+}}$

$= 0{,}771 + 0{,}02569 \ln 0{,}4 = 0{,}747\ V$

g) $Hg_2Cl_2 \rightarrow 2Hg^+ + 2Cl^-$

$2Hg^+ + 2e \rightarrow 2Hg^\circ$

$E = E^\circ_{(Hg^+/Hg)} + \frac{RT}{kF} \ln a_{Hg^+}$

$[Hg^+]^2 [Cl^-]^2 = K_s(Hg_2Cl_2)$

$[Hg^+]^2 \cdot 1{,}5^2 = \ldots$ nelze dopočítat, $K_s(Hg_2Cl_2)$ není v tabulkách

str. 143: $E = E^\circ_{Hg_2Cl_2/Hg} - \frac{RT}{F} \ln a_{Cl^-}$

Postup: str. 143 + str. 171 jiné zadání podobně

$= 0{,}2676 - \frac{8{,}314 \cdot 298{,}15}{96500} \ln 1{,}5$

$= 0{,}2676 - 0{,}02569 \cdot 0{,}4055 = 0{,}257\ V$

147/ ① $t = \frac{mkF}{IM} = \frac{1 \cdot 2 \cdot 96500}{0{,}8 \cdot 58{,}71} = 4103\ s = 1{,}14\ h = 1\ h\ 8{,}5\ min$

② $m = \frac{IdM}{kF} \Rightarrow \frac{m}{M} = \frac{Id}{kF} \Rightarrow n = \frac{Id}{kF}$

$pV = nRT \Rightarrow n = \frac{pV}{RT} = \frac{101325 \cdot 100 \cdot 10^{-3} \cdot 10^{-3}}{8{,}314 \cdot 298{,}15} = 4{,}088 \cdot 10^{-3}\ mol$

a) $4{,}088 \cdot 10^{-3} = \frac{I \cdot 30 \cdot 60}{2 \cdot 96500} \Rightarrow I = 0{,}44\ A$

$2Cl^- \rightarrow Cl_2$

b) $Q = n \cdot F \cdot 2 = 4{,}088 \cdot 10^{-3} \cdot 2 \cdot 1{,}602 \cdot 10^{-19} \cdot N_A = 1{,}31 \cdot 10^{-21} \cdot 6{,}022 \cdot 10^{23} = 789\ C$

c) $n(NaOH) = 2n(Cl_2) = 2 \cdot 4{,}088 \cdot 10^{-3} = 8{,}176 \cdot 10^{-3}\ mol$ $\quad m = M \cdot n = 40 \cdot 8{,}176 \cdot 10^{-3} = 0{,}327\ g$