3. házi feladat

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1. feladat: $[CaCl_2] = 0{,}5\ M$
$T = 25\,°C = 298\,K$
$I = ?$
$\gamma_\pm = ?$

$z_{Ca^{2+}} = 2$ $\quad c_{Ca^{2+}} = x = 0{,}5$

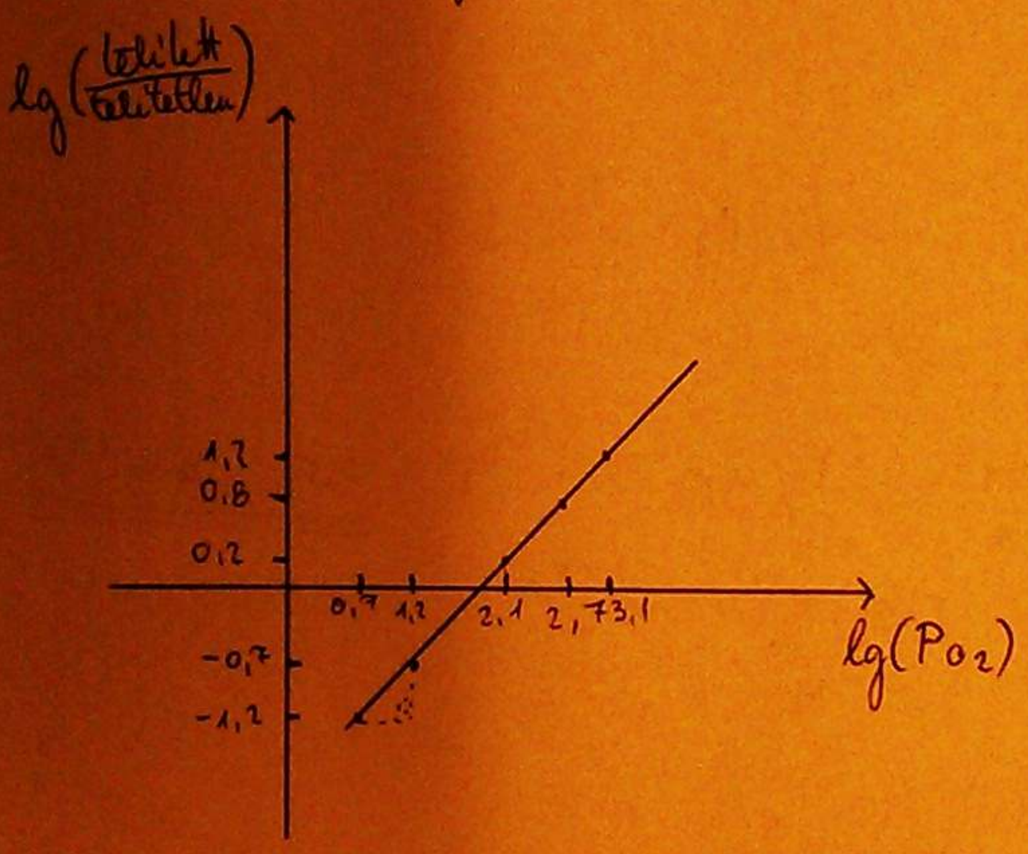
$z_{Cl^-} = -1$ $\quad c_{Cl^-} = 2x = 1$

$$I = \frac{1}{2}\sum c_i z_i^2 = \frac{1}{2}(4 \cdot 0{,}5 + 2 \cdot 0{,}5) = 3 \cdot 0{,}5 = \underline{\underline{1{,}5}}$$

$$\lg \gamma_\pm = -0{,}51 \cdot |z_+ \cdot z_-| \cdot I^{\frac{1}{2}} = -0{,}51 \cdot |2 \cdot (-1)(-1)| \cdot \sqrt{1{,}5}$$

$$\gamma_\pm = 10^{-0{,}51 \cdot 2 \cdot \sqrt{1{,}5}} = \underline{\underline{0{,}10563}}$$

3. feladat: A fehérje



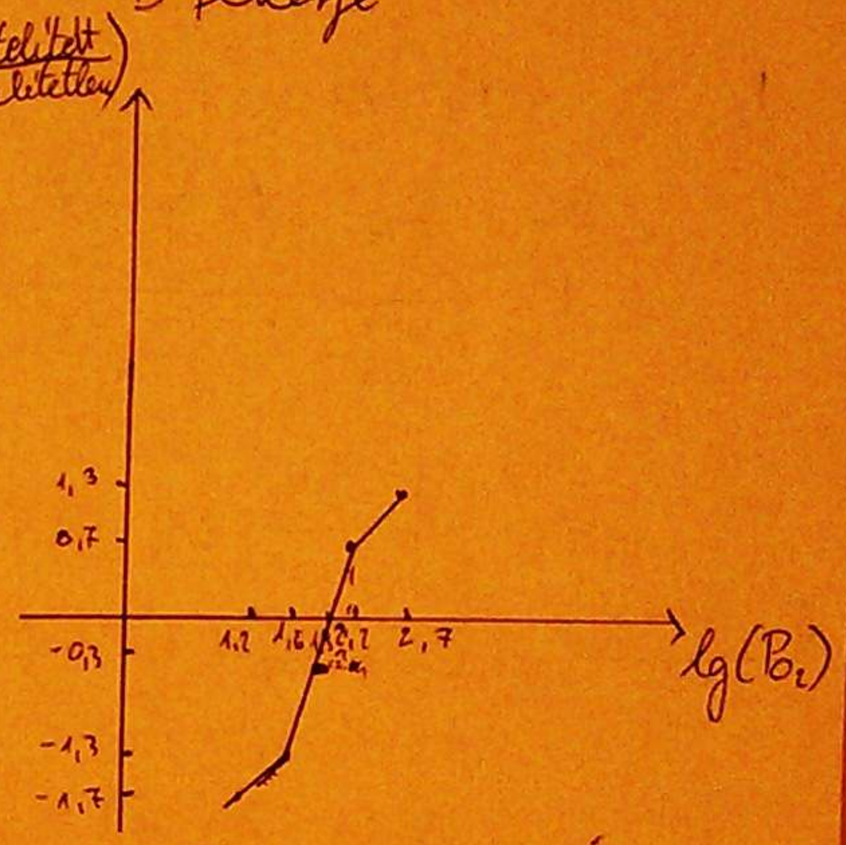
$$n = \frac{0{,}5}{0{,}5} = 1 = x_A$$

Az A fehérje nem köti kooperatívan az oxigént, mert a kooperativitás mértéke, $x_A = 1$.

$$n_{min\,A} \geq x_A = 1$$

$$n_{min\,A} = 1$$

B fehérje



$$n = \frac{1{,}3}{0{,}4} = \frac{3{,}33}{1} = x_B = \underline{\underline{3{,}33}}$$

erős a kooperativitás mértéke

$$n_{min\,B} \geq x_B = 3{,}33$$

$$n_{min\,B} = 4$$

Hill plot: $\lg\left(\frac{Y}{1-Y}\right) = \lg k + x \cdot \lg[A]$ $\qquad \left(\frac{Y}{1-Y}\right) = \left(\frac{telített}{telítetlen}\right)$

$[A] \sim pO_2$ Raoult törvény

$A - O_2$

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4. feladat: $\Delta\phi = -80\,mV = -0{,}08\,V$

$[K^+]_k = 200\,mM = 0{,}2\,M$

$T = 20°C = 293\,K$

$R = 8{,}314\ J/mol$

$F = 96500\ C/mol$

$z = 1$

a, $\Delta\phi = \frac{RT}{zF} \ln \frac{[K^+]_k}{[K^+]_b}$

$e^{\frac{\Delta\phi z F}{RT}} = \frac{[K^+]_k}{[K^+]_b}$

$[K^+]_b = \frac{[K^+]_k}{e^{\frac{\Delta\phi z F}{RT}}} = \frac{0{,}2}{e^{\frac{-0{,}08 \cdot 1 \cdot 96500}{8{,}314 \cdot 293}}} = \frac{0{,}2}{0{,}04204} = \underline{\underline{4{,}757\,M}}$

b, $T_2 = 40°C = 313\,K$

$\frac{\Delta\phi_2}{\Delta\phi} = \frac{\frac{RT_2}{zF} \cdot \ln \frac{[K^+]_k}{[K^+]_b}}{\frac{RT}{zF} \cdot \ln \frac{[K^+]_k}{[K^+]_b}} = \frac{T_2}{T} \rightarrow \Delta\phi_2 = \frac{T_2}{T}\Delta\phi$

$\Delta\phi_2 - \Delta\phi = \frac{T_2}{T}\Delta\phi - \Delta\phi = \left(\frac{313}{293} - 1\right)(-80 \cdot 10^{-3})\,V = \underline{\underline{-5{,}46\,mV}}$

5. feladat: $[Ca^{2+}]_k = 1{,}5\,mM = 0{,}0015\,M = 1{,}5 \cdot 10^{-3}\,M$

$[Ca^{2+}]_b = 0{,}4\,\mu M = 0{,}4 \cdot 10^{-6}\,M$

$z = 2$

$\Delta\phi = -60\,mV = -0{,}06\,V$

$n_{Ca^{2+}} = 2\,mmol = 0{,}002\,mol$

$\Delta G = ?$

$\Delta G = n \cdot \Delta\bar{G}$

$\Delta\bar{G} = RT \ln \frac{[Ca^{2+}]_k}{[Ca^{2+}]_b} - zF\Delta\phi = 8{,}314\ J/mol \cdot 310K \cdot \ln \frac{1{,}5 \cdot 10^{-3}\,M}{0{,}4 \cdot 10^{-6}\,M} + 2 \cdot 96500\ C/mol \cdot 60 \cdot 10^{-3}\,V = \underline{\underline{32790{,}25\ J/mol}}$

$\Delta G = n \cdot \Delta\bar{G} = 0{,}002\,mol \cdot 32790{,}25\ J/mol = \underline{\underline{65{,}58\,J}}$

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6. feladat:

$w = 0,1$

$Z_0 = -18$

$z = +2$

$$Z = Z_0 + z\overline{V}$$

$$\frac{\overline{U}}{[A]\,e^{-2wZz}} = -k_a\overline{V} + n\,k_a$$

$\overline{U}$ → telítettség

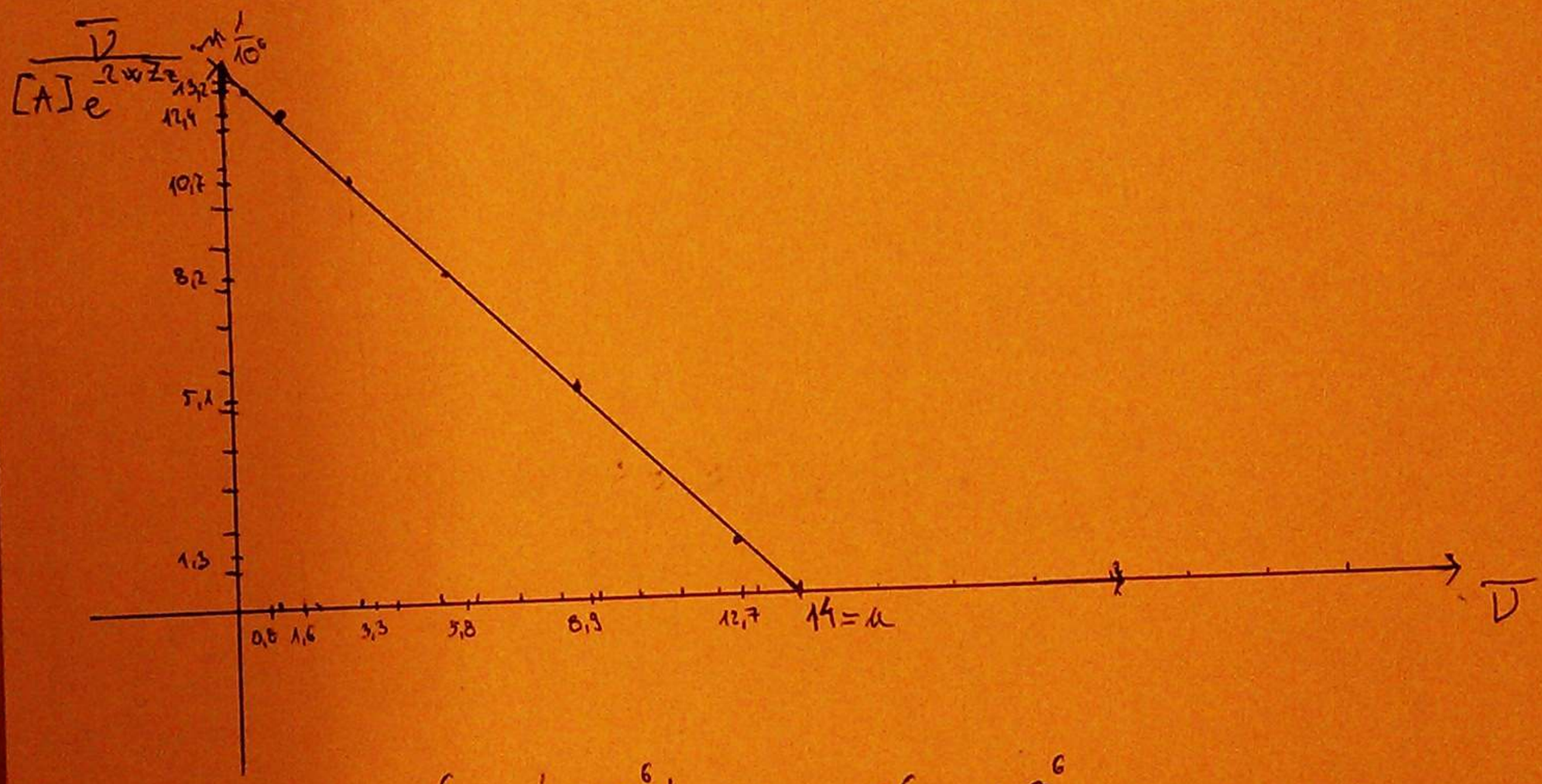
$[A]$ ← ligandum cc-ja

e^{-2wZz}: Z → ligandum egész töltése; z → ligandum töltése

n → kötőhelyek száma

k_a → belső kötési állandó

$[A]$ M/l	$\overline{V}$	Z	$\frac{\overline{V}}{[A]e^{-2wZz}}$
$8,58 \cdot 10^{-11}$	0,8	−16,4	$13,2 \cdot 10^6$
$3,46 \cdot 10^{-10}$	1,6	~~−13,2~~ −14,8	$12,4 \cdot 10^6$
$3,23 \cdot 10^{-9}$	3,3	~~−6,6~~ −11,4	$10,7 \cdot 10^6$
$5,47 \cdot 10^{-8}$	5,8	~~−5~~ −6,4	$8,2 \cdot 10^6$
$1,61 \cdot 10^{-6}$	8,9	~~−2,8~~ −0,2	$5,1 \cdot 10^6$
$1,89 \cdot 10^{-4}$	12,7	~~4,8~~ 7,4	$1,3 \cdot 10^6$



$$k_a = \left| \frac{8,2 \cdot 10^6 - 5,1 \cdot 10^6}{5,8 - 8,9} \right| = +1 \cdot 10^6 = \underline{\underline{10^6}}$$

mert $\frac{\overline{V}}{[A]e^{-2wZz}} = -k_a\overline{V} + n\,k_a$

mert ~~$n\,k_a = \overline{V}\,k_a$~~

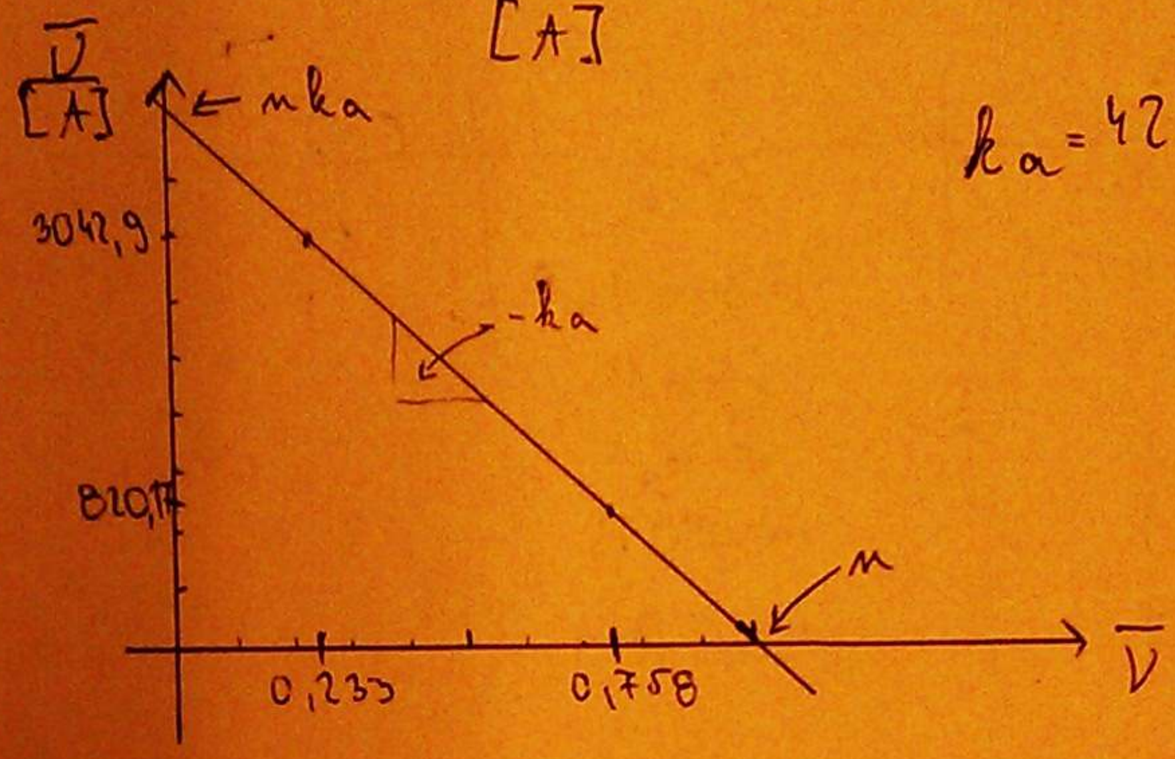
$n\,k_a = \overline{V}\,k_a$ $\quad 13,2 \cdot 10^6 = -0,8 \cdot 10^6 + n \cdot 10^6$

$n = 14$

2 feladat.

$[7MN]_{kezdeti}$ [M]	$[7MN]_{vég}$ [M]	$\bar{v}$	$\frac{\bar{v}}{[7MN]_{kezdeti}}$
10^{-3}	$9{,}242 \cdot 10^{-4}$	0,756	820,17
10^{-4}	$7{,}667 \cdot 10^{-5}$	0,233	3042,9

$$\bar{v} = \frac{n\,ka[A]^n}{1 + ka[A]^n} \longrightarrow \frac{\bar{v}}{[A]} = nka - \bar{v}ka$$



$ka = 4230{,}121 \rightarrow n = 0{,}95$