

1.

Elsör-diskid:

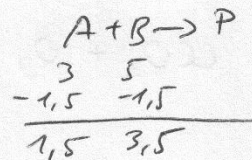
(B)

$$C_{A,0} = 3 \frac{\text{mmol}}{\text{dm}^3}$$

$$\rightarrow C_{A,t} = 1,5 \frac{\text{mmol}}{\text{dm}^3}$$

$$C_{B,0} = 5 \frac{\text{mmol}}{\text{dm}^3}$$

$$\rightarrow C_{B,t} = 3,5 \frac{\text{mmol}}{\text{dm}^3}$$



$$t_{1/2} = \frac{1}{k(C_{B,0} - C_{A,0})} \cdot \ln \left( \frac{C_{B,t} C_{A,0}}{C_{A,t} C_{B,0}} \right) = \underline{\underline{94,5 \text{ s}}}$$

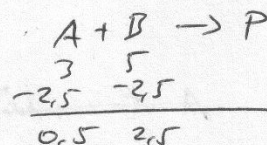
övrö:

$$C_{A,0} = 3 \frac{\text{mmol}}{\text{dm}^3}$$

$$\rightarrow C_{A,t} = 0,5 \frac{\text{mmol}}{\text{dm}^3}$$

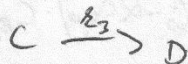
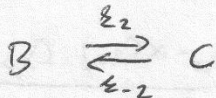
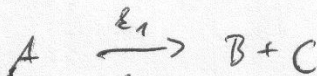
$$C_{B,0} = 5 \frac{\text{mmol}}{\text{dm}^3}$$

$$\rightarrow C_{B,t} = 2,5 \frac{\text{mmol}}{\text{dm}^3}$$



$$t_{1/2} = \underline{\underline{308,6 \text{ s}}}$$

2.



$$\frac{d[D]}{dt} = ?$$

$$t = 1 \text{ min}$$

$$[A]_0 = 0,51 \frac{\text{mol}}{\text{dm}^3}$$

$$\frac{d[B]}{dt} \approx 0 \text{ és } \frac{d[C]}{dt} \approx 0$$

$$\frac{d[B]}{dt} = k_1[A] - k_2[B] + k_{-2}[C] \approx 0$$

$$\frac{d[C]}{dt} = k_1[A] + k_2[B] - k_{-2}[C] - k_3[C] \approx 0 \quad \left. \vphantom{\frac{d[C]}{dt}} \right\} (+)$$

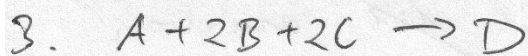
$$2 k_1[A] = k_3[C]$$

( $k_2$ -es és  $k_{-2}$ -es közel  
kiesmé)

$$\frac{d[D]}{dt} = k_3[C] = k_3 \cdot \frac{2k_1}{k_3} [A] = 2k_1[A] = 2k_1[A]_0 \cdot \exp(-k_1 t)$$

Mivel A-t csak az első  
reakció fogyasztja  $\Rightarrow$  Első. kin.

$$\frac{d[D]}{dt} = 2 \cdot 0,187 \text{ s}^{-1} \cdot 0,51 \frac{\text{mol}}{\text{dm}^3} \cdot \exp(-0,187 \text{ s}^{-1} \cdot 60 \text{ s}) = \underline{\underline{2,557 \cdot 10^{-6} \frac{\text{mol}}{\text{dm}^3 \text{ s}}}}$$



$$r = k \cdot C_A^{u_A} \cdot C_B^{u_B} \cdot C_C^{u_C}$$

$$2. \text{ e } 4. \text{ nivel: } \left( \frac{145}{897} \right)^{u_A} = \frac{1,253 \cdot 10^{-3}}{1,192 \cdot 10^{-4}} \rightarrow \underline{u_A = 2,5}$$

$$1. \text{ e } 2. \text{ nivel: } \left( \frac{208}{145} \right)^{2,5} \cdot \left( \frac{396}{248} \right)^{u_C} = \frac{3,901}{1,253} \rightarrow \underline{u_C = 0,5}$$

$$2. \text{ e } 3. \text{ nivel: } \left( \frac{145}{486} \right)^{2,5} \cdot \left( \frac{503}{247} \right)^{u_B} \cdot \left( \frac{248}{312} \right)^{0,5} = \frac{1,253 \cdot 10^{-3}}{2,889 \cdot 10^{-2}} \rightarrow \underline{u_B = 0}$$

$$r = k \cdot C_A^{2,5} \cdot C_C^{0,5}$$

$$k = r \cdot C_A^{-2,5} \cdot C_C^{-0,5} \xrightarrow{1. \text{ nivel}} \underline{k = 0,314 \frac{\text{dm}^6}{\text{mol}^2 \cdot \text{s}}}$$

$$+)$$

$$C_A = 0,0124 \frac{\text{mol}}{\text{dm}^3}$$

$$C_B = 0,0756 \frac{\text{mol}}{\text{dm}^3}$$

$$C_C = 0,0254 \frac{\text{mol}}{\text{dm}^3} = 2,54 \cdot 10^{-8} \frac{\text{mol}}{\text{dm}^3} \rightarrow \text{preendo "feble" "reacão"}$$

$$k' = k \cdot C_A^{2,5} = 0,314 \frac{\text{dm}^6}{\text{mol}^2 \cdot \text{s}} \cdot \left( 0,0124 \frac{\text{mol}}{\text{dm}^3} \right)^{2,5} =$$

$$k' = 5,376 \cdot 10^{-6} \frac{\text{mol}^{0,5}}{\text{dm}^{1,5} \cdot \text{s}}$$

$$t_{1/2} = \frac{2^{u-1} - 1}{(u-1)k' \cdot C_0^{u-1}} = \frac{2^{-0,5} - 1}{-0,5 \cdot 2k' \cdot (2,54 \cdot 10^{-8} \frac{\text{mol}}{\text{dm}^3})^{-0,5}} = \underline{8,68 \text{ s}}$$

$$C_t^{1-u} = C_0^{1-u} + (u-1)kt \rightarrow t_{1/3} = \frac{(1/3 C_0^{0,5}) - C_0^{0,5}}{-0,5 \cdot 2k'} = \underline{17,72 \text{ s}}$$

$$C_0 = 2 \cdot 2,54 \cdot 10^{-8} \frac{\text{mol}}{\text{dm}^3}$$

4. a) Azon keletlenül a két lennél 1:1 arányban,  
ha  $k_1(T) = k_2(T)$ , azaz

$$A_1 \cdot \exp\left(-\frac{E_{a,1}}{RT}\right) = A_2 \exp\left(-\frac{E_{a,2}}{RT}\right)$$

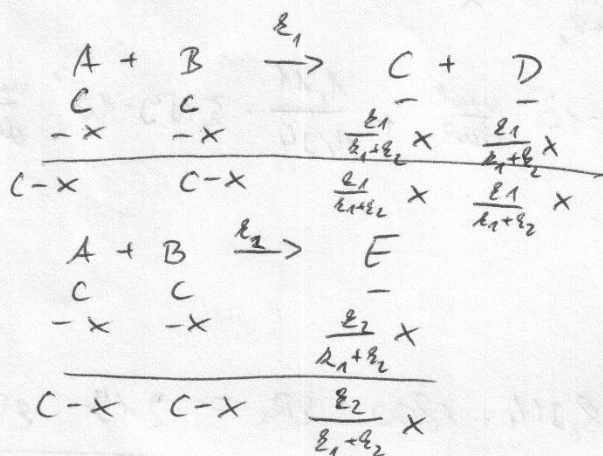
$$\frac{A_1}{A_2} = \exp\left(\frac{1}{RT}(E_{a,1} - E_{a,2})\right)$$

$$T = \frac{E_{a,1} - E_{a,2}}{R \cdot \ln(A_1/A_2)} = \underline{\underline{1350 \text{ K}}}$$

b) A gázelegy koncentrációja leszdetben:

$$C_{\text{öss}} = \frac{n}{V} = \frac{P}{RT} = \frac{300 \text{ kPa}}{8,314 \frac{\text{J}}{\text{mol K}} \cdot 1800 \text{ K}} = 0,02005 \frac{\text{mol}}{\text{dm}^3}$$

A reakció előrehaladása:



$$\text{Itt } C = \frac{C_{\text{öss}}}{2}$$

Teljesen a  $t = 0,5 \text{ min}$  időpillanatokban az összkoncentráció:

$$\begin{aligned} 2(C-x) + 2 \cdot \frac{k_1}{k_1+k_2}x + \frac{k_2}{k_1+k_2}x &= 2(C-x) + x \cdot \left(\frac{2k_1}{k_1+k_2} + \frac{k_2}{k_1+k_2}\right) = \\ &= 2(C-x) + x \cdot \left(\frac{k_1}{k_1+k_2} + 1 \cdot \frac{k_1+k_2}{k_1+k_2}\right) = 2C - x + \frac{k_1}{k_1+k_2}x \end{aligned}$$

$k_1$  és  $k_2$  meghatározására 1800K-en:

$$k_1 = A_1 \cdot \exp\left(-\frac{E_a}{R \cdot 1800 \text{ K}}\right) = 0,68 \cdot 10^{-2} \cdot 1,11 \frac{\text{dm}^3}{\text{mol s}}$$

$$k_2 = A_2 \cdot \exp\left(-\frac{E_a}{R \cdot 1800 \text{ K}}\right) = 0,829 \frac{\text{dm}^3}{\text{mol s}}$$

$$k' = k_1 + k_2 = 1,94 \frac{\text{dm}^3}{\text{mol s}} \quad \leftarrow \text{A mikrokanál bontás katalízis együtthatója}$$

Uzdevums:

$$\frac{d[A]}{dt} = -\varepsilon_1[A][B] - \varepsilon_2[A][B] = -(\varepsilon_1 + \varepsilon_2)[A][B]$$

Tātāt:

$$C_t^{-1} = C_0^{-1} + \varepsilon' t \quad (C_0 = 0,01009 \frac{\text{mol}}{\text{dm}^3})$$

$$C_t = \left( (0,01 \frac{\text{mol}}{\text{dm}^3})^{-1} + 1,94 \frac{\text{dm}^3}{\text{mol}} \cdot 30,7 \right)^{-1} = 6,33 \cdot 10^{-3} \frac{\text{mol}}{\text{dm}^3}$$

$$X = C_0 - C_t = 0,01009 \frac{\text{mol}}{\text{dm}^3} - 6,33 \cdot 10^{-3} \frac{\text{mol}}{\text{dm}^3} = 3,759 \cdot 10^{-3} \frac{\text{mol}}{\text{dm}^3}$$

Tātāt šēl pēc mīkloa or ommkoncentraciōs

$$C_{m,2} = 2 \cdot C_0 - X + \frac{\varepsilon_1}{\varepsilon_1 + \varepsilon_2} \cdot X =$$

$$= 0,02005 \frac{\text{mol}}{\text{dm}^3} - 3,759 \cdot 10^{-3} \frac{\text{mol}}{\text{dm}^3} + \frac{1,11}{1,94} \cdot 3,759 \cdot 10^{-3} \frac{\text{mol}}{\text{dm}^3} =$$

$$= 0,01844 \frac{\text{mol}}{\text{dm}^3}$$

A uzmaīs tēro?

$$p = CRT = 0,01844 \cdot 8,314 \cdot 1800 \text{ Pa} = \underline{\underline{276 \text{ Pa}}}$$

(A)

1.  $T_1 = 50^\circ\text{C} = 323,15\text{ K}$

$\alpha_1 = 60\% \rightarrow C_t = 0,4 C_0$

$T_2 = 70^\circ\text{C} = 343,15\text{ K}$

$\alpha_2 = 85\% \rightarrow C_t = 0,15 C_0$

$E_a = 97,43\text{ kJ/mol} = 97430\text{ J/mol}$

$$\frac{k_1}{k_2} = \frac{A_1 \cdot \exp\left(-\frac{E_a}{RT_1}\right)}{A_2 \cdot \exp\left(-\frac{E_a}{RT_2}\right)} = \exp\left(\frac{E_a}{R} \left(\frac{1}{T_2} - \frac{1}{T_1}\right)\right) = \underline{0,1208}$$

Vizsgálgat a 1, 2, 3-ad rendűt!

$n=1 \Rightarrow C_t = C_0 \cdot \exp(-kt) \rightarrow k = \frac{\ln(C_t/C_0)}{-t}$

$$\frac{k_1}{k_2} = \frac{\ln(C_{t,1}/C_0)}{\ln(C_{t,2}/C_0)} = \frac{\ln(0,4 C_0/C_0)}{\ln(0,15 C_0/C_0)} = \frac{\ln(0,4)}{\ln(0,15)}$$

$\frac{k_1}{k_2} = 0,483 \neq 0,1208 \Rightarrow \text{nem elsőrendű.}$

$n=2 \Rightarrow C_t^{-1} = C_0^{-1} + kt \rightarrow k = \frac{C_t^{-1} - C_0^{-1}}{t}$

$$\frac{k_1}{k_2} = \frac{C_{t,1}^{-1} - C_0^{-1}}{C_{t,2}^{-1} - C_0^{-1}} = \frac{C_0^{-1}(0,4^{-1} - 1)}{C_0^{-1}(0,15^{-1} - 1)} = \frac{0,4^{-1} - 1}{0,15^{-1} - 1}$$

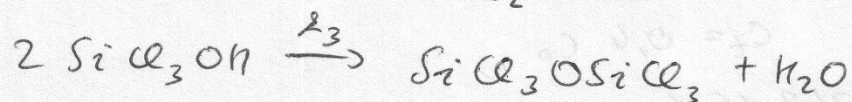
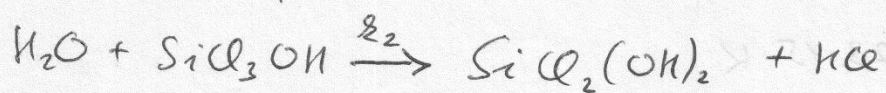
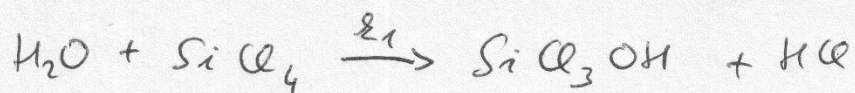
$\frac{k_1}{k_2} = 0,2647 \neq 0,1208 \Rightarrow \text{nem másodrendű.}$

$n=3 \Rightarrow C_t^{-2} = C_0^{-2} + 2kt \rightarrow k = \frac{C_t^{-2} - C_0^{-2}}{2t}$

$$\frac{k_1}{k_2} = \frac{C_{t,1}^{-2} - C_0^{-2}}{C_{t,2}^{-2} - C_0^{-2}} = \frac{C_0^{-2}(0,4^{-2} - 1)}{C_0^{-2}(0,15^{-2} - 1)} = \frac{0,4^{-2} - 1}{0,15^{-2} - 1}$$

$\frac{k_1}{k_2} = 0,1208 \checkmark \Rightarrow \text{A reakció harmadrendű.}$

2.



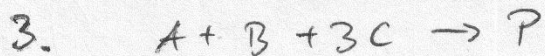
a)

$$\frac{d[\text{SiCl}_3\text{OH}]}{dt} = k_1[\text{H}_2\text{O}][\text{SiCl}_4] - k_2[\text{H}_2\text{O}][\text{SiCl}_3\text{OH}] - 2k_3[\text{SiCl}_3\text{OH}]^2$$

másodfokú egyenlet megoldó képletéből:

$$[\text{SiCl}_3\text{OH}] = \frac{k_2[\text{H}_2\text{O}] - \sqrt{k_2^2[\text{H}_2\text{O}]^2 + 8k_1k_3[\text{H}_2\text{O}][\text{SiCl}_4]}}{-4k_3}$$

Csak a  $\ominus$  megoldás jó, mert csak így lehet a  $[\text{SiCl}_3\text{OH}]$  pozitív.



$$r = k \cdot C_A^{n_A} \cdot C_B^{n_B} \cdot C_C^{n_C} \quad k, n_A, n_B, n_C = ?$$

1. e; 3. nowel:  $\left(\frac{248}{158}\right)^{n_C} = \left(\frac{1,015 \cdot 10^{-2}}{5,159 \cdot 10^{-3}}\right) \rightarrow \underline{n_C = 1,5}$

3. e; 4. nowel:  $\left(\frac{278}{987}\right)^{n_A} \cdot \left(\frac{158}{143}\right)^{1,5} = \left(\frac{5,159 \cdot 10^{-3}}{1,577 \cdot 10^{-2}}\right) \rightarrow \underline{n_A = 1}$

1. e; 2. nowel:  $\left(\frac{278}{540}\right)^1 \cdot \left(\frac{495}{102}\right)^{n_B} \cdot \left(\frac{248}{534}\right)^{1,5} = \left(\frac{1,015}{2,827}\right) \rightarrow \underline{n_B = 0,5}$

$$r = k \cdot C_A \cdot C_B^{0,5} \cdot C_C^{1,5}$$

$$k = r \cdot C_A^{-1} \cdot C_B^{-0,5} \cdot C_C^{-1,5} \xrightarrow{1. \text{ nowel}} k = 420 \frac{\text{dm}^6}{\text{mol}^2 \cdot \text{s}}$$

+)  $C_A = 0,134 \frac{\text{mol}}{\text{dm}^3}$   
 $C_B = 0,856 \frac{\text{mol}}{\text{dm}^3} \rightarrow$  pseudo "felel" reactant  
 $C_C = 0,302 \frac{\text{mol}}{\text{dm}^3}$

$$t_{1/2} = \frac{2^{n-1} - 1}{(n-1) \cdot k' \cdot C_0^{n-1}}$$

$$k' = k \cdot C_A \cdot C_C^{1,5} = 420 \frac{\text{dm}^6}{\text{mol}^2 \cdot \text{s}} \cdot 0,134 \frac{\text{mol}}{\text{dm}^3} \cdot \left(0,302 \frac{\text{mol}}{\text{dm}^3}\right)^{1,5}$$

$$k' = 9,34 \frac{\text{mol}^{0,5}}{\text{dm}^{1,5} \cdot \text{s}}$$

$$t_{1/2} = \frac{2^{-0,5} - 1}{-0,5 \cdot 9,34 \frac{\text{mol}^{0,5}}{\text{dm}^{1,5} \cdot \text{s}} \cdot \frac{1}{3} \cdot \left(8,56 \cdot 10^{-2} \frac{\text{mol}}{\text{dm}^3}\right)^{-0,5}} = 5,79 \cdot 10^{-5} \text{ s}$$

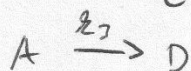
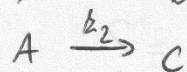
$$C_t^{+0,5} = C_0^{0,5} + 0,5 k' t$$

$$C_0 = 2 \cdot 0,856 \frac{\text{mol}}{\text{dm}^3} = 1,712 \frac{\text{mol}}{\text{dm}^3}$$

$$\hookrightarrow C_t = \frac{1}{3} C_0$$

$$t_{1/3} = \frac{(1/3 C_0)^{0,5} - C_0^{0,5}}{-0,5 k'} = 0,118 \text{ s}$$

$$4. \quad A \xrightarrow{k_1} B \quad [A]_0 = 0,02 \frac{\text{mmol}}{\text{dm}^3}$$



$$t = 5 \text{ min}$$

$$[B]_t = 0,41 \frac{\text{mmol}}{\text{dm}^3}$$

$$[C]_t = 13 \frac{\text{mmol}}{\text{dm}^3}$$

$$t_{1/2, A} = 184 \text{ s}$$

$$a) \quad \frac{d[A]}{dt} = -k_1[A] - k_2[A] - k_3[A] = -\underbrace{(k_1 + k_2 + k_3)}_{k'} [A]$$

$$t_{1/2} = \frac{\ln 2}{k'} \Rightarrow k' = \frac{\ln 2}{184 \text{ s}} = 3,767 \cdot 10^{-3} \text{ s}^{-1}$$

Az A B, a C és a D  $k_1 : k_2 : k_3$  arányban keletkezik.

$$5 \text{ perc alatt: } [A]_t = [A]_0 \cdot \exp(-k' t) = 6,46 \cdot 10^{-3} \frac{\text{mmol}}{\text{dm}^3}$$

$$\text{azaz } [A]_0 - [A]_t = 0,01354 \frac{\text{mmol}}{\text{dm}^3} \text{ A fogyott.}$$

$$\text{Ebből B } \frac{k_1}{k_1 + k_2 + k_3} = \frac{k_1}{k'} \text{ arányban, C pedig } \frac{k_2}{k'} \text{ arányban keletkezik.}$$

$$\frac{k_1}{k'} \cdot 0,01354 \frac{\text{mmol}}{\text{dm}^3} = 0,41 \frac{\text{mmol}}{\text{dm}^3} = 4,1 \cdot 10^{-4} \frac{\text{mmol}}{\text{dm}^3}$$

$$k_1 = k' \cdot \frac{4,1 \cdot 10^{-4}}{0,01354} = \underline{\underline{1,14 \cdot 10^{-4} \text{ s}^{-1}}}$$

$$\frac{k_2}{k'} \cdot 0,01354 \frac{\text{mmol}}{\text{dm}^3} = 13 \frac{\text{mmol}}{\text{dm}^3} = 1,3 \cdot 10^{-2} \frac{\text{mmol}}{\text{dm}^3}$$

$$k_2 = k' \cdot \frac{1,3 \cdot 10^{-2}}{0,01354} = \underline{\underline{3,617 \cdot 10^{-3} \text{ s}^{-1}}}$$

$$k_3 = k' - k_1 - k_2 = \underline{\underline{3,6 \cdot 10^{-5} \text{ s}^{-1}}}$$

$$b) \quad [C]_t = \frac{k_3}{k'} \cdot 0,01354 \frac{\text{mmol}}{\text{dm}^3} = \underline{\underline{1,294 \cdot 10^{-4} \frac{\text{mmol}}{\text{dm}^3}}}$$