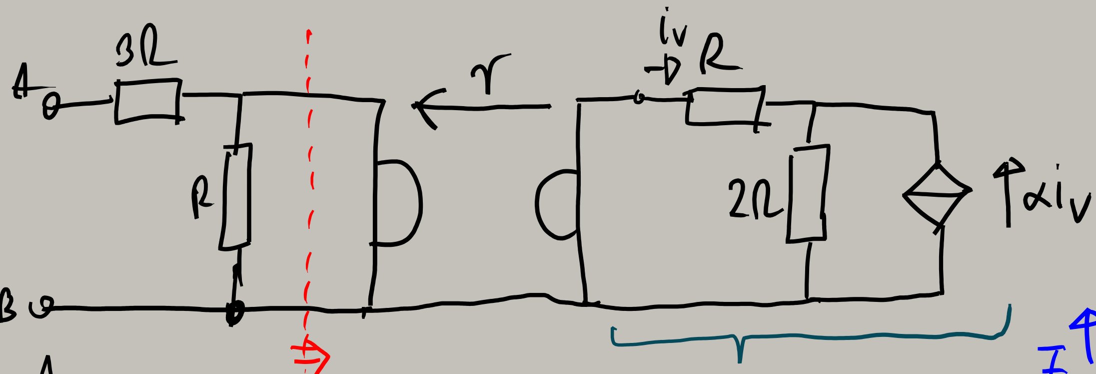
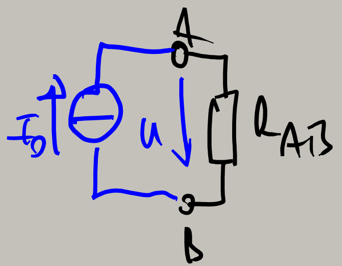
1)



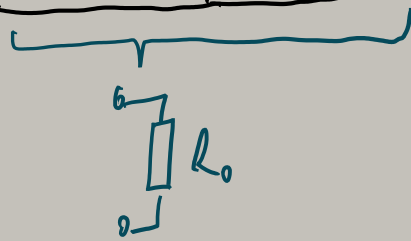
$R_{AB} = ?$

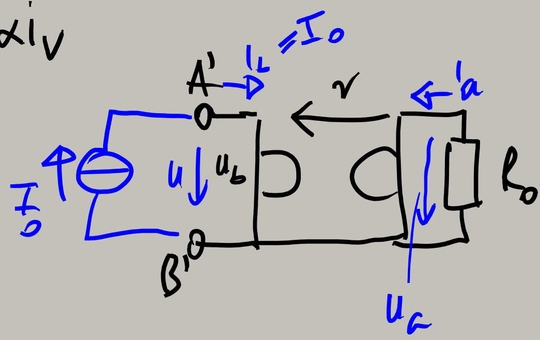
$\Rightarrow$



$U = I_0 \cdot R_{AB}$

$R_{AB} = \frac{U}{I_0}$





1) $U = U_b = r \cdot I_a$

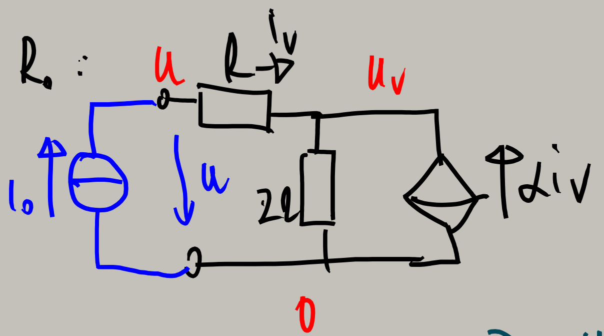
2) $U_a = -r \cdot I_b = -r \cdot I_0$

3) $U_a = R_0 \cdot (-I_a)$

$U = r \cdot \left(-\frac{U_a}{R_0}\right) = -\frac{r}{R_0} \cdot -r I_0 = \frac{r^2}{R_0} \cdot I_0$

$R_{AB} = \frac{U}{I_0} = \frac{r^2}{R_0}$

R_0 :



$I_0 = I_v$

$-\alpha \cdot I_v + \frac{U_v}{2R} + \frac{U_v - U}{R} = 0$

$I_v = \frac{U - U_v}{R}$

U, I_v, U_v

$3U_v - 2U - 2R\alpha I_0 = 0$

$U_v = \frac{2U + 2R\alpha I_0}{3}$

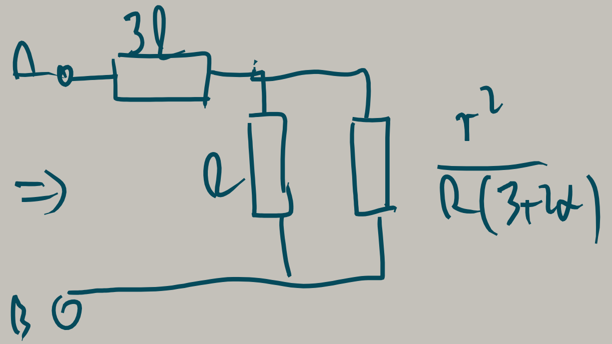
$U - I_0 R = \frac{2}{3} U + \frac{2R}{3} \alpha I_0$

$\frac{1}{3} U = I_0 R \left(1 + \frac{2\alpha}{3}\right) \rightarrow U = I_0 R (3 + 2\alpha)$

$R_0 = \dfrac{U}{I_0} = \boxed{R(3+2\alpha)}$ előző rész eredménye alapján a piros vonaltól jobbra

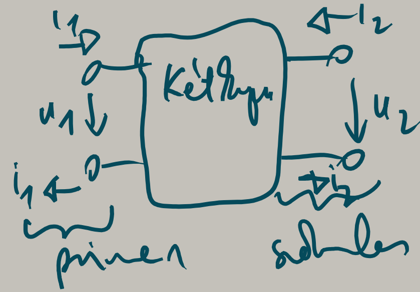
$$\Rightarrow R_{AB} = \frac{r^2}{R_0} = \frac{r^2}{R(3+2\alpha)}$$

$\Rightarrow$



$$R_{AB} = \left(R \times \frac{r^2}{R(3+2\alpha)}\right) + 3R = \ldots$$

Kétkapu: (Two-port)



u_1, i_1, u_2, i_2

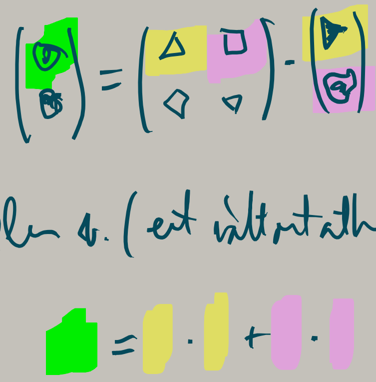
lineáris kétkapu

$$\begin{pmatrix} \cdot \\ \cdot \end{pmatrix} = \begin{pmatrix} \cdot & \cdot \\ \cdot & \cdot \end{pmatrix} \cdot \begin{pmatrix} \cdot \\ \cdot \end{pmatrix}$$

függő változók

karakterisztikus mátrix

független v. (ált. változók)



hibrid típusú kar.

u_1 v. i_1

$$\begin{pmatrix} g_1 \\ g_2 \end{pmatrix} = \begin{pmatrix} & \\ & \end{pmatrix} \cdot \begin{pmatrix} g_1 \\ g_2 \end{pmatrix}$$

u_2 v. i_2

lánc típusú kar.

$$\begin{pmatrix} u_1 \\ i_1 \end{pmatrix} = \begin{pmatrix} & \\ & \end{pmatrix} \begin{pmatrix} u_2 \\ i_2 \end{pmatrix}$$

vagy fordítva

4 féle

hibrid

R, G, H, K

inverz hibrid

(Z), (Y)

$[\Omega]$ $[S]$

$$\begin{pmatrix} u_1 \\ u_2 \end{pmatrix} = \begin{pmatrix} R_{11} & R_{12} \\ R_{21} & R_{22} \end{pmatrix} \cdot \begin{pmatrix} i_1 \\ i_2 \end{pmatrix}$$

$$\begin{pmatrix} i_1 \\ i_2 \end{pmatrix} = \begin{pmatrix} G_{11} & G_{12} \\ G_{21} & G_{22} \end{pmatrix} \begin{pmatrix} u_1 \\ u_2 \end{pmatrix}$$

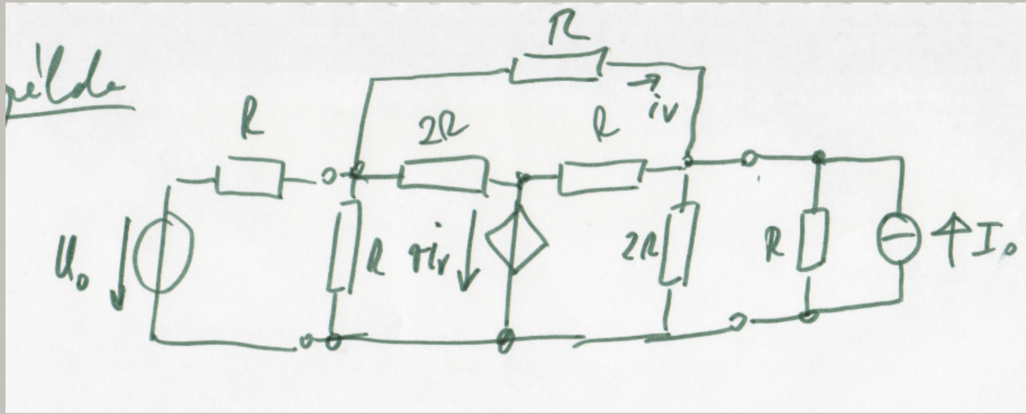
$$\underbrace{u_1}_{[\Omega]} = H_{11} \cdot i_1 + \underbrace{H_{12}}_{[1]} \cdot u_2$$

$$\begin{pmatrix} u_1 \\ i_2 \end{pmatrix} = \begin{pmatrix} H_{11} & H_{12} \\ H_{21} & H_{22} \end{pmatrix} \cdot \begin{pmatrix} i_1 \\ u_2 \end{pmatrix}$$

H_{22}: $[1/\Omega]$

H_{21}: $[1]$

$$\begin{pmatrix} i_1 \\ u_2 \end{pmatrix} = \begin{pmatrix} & \\ & \end{pmatrix} \begin{pmatrix} u_1 \\ i_2 \end{pmatrix}$$



1)
2)
3)

$$\begin{pmatrix} \quad \end{pmatrix}\begin{pmatrix} u_1 \\ i_2 \\ i_V \end{pmatrix} = \begin{pmatrix} \quad \end{pmatrix}\begin{pmatrix} i_1 \\ u_2 \end{pmatrix}$$

$(-1)\ (-1)$

$$\begin{pmatrix} \quad \end{pmatrix}\begin{pmatrix} u_1 \\ i_1 \\ u_2 \\ i_2 \\ i_V \end{pmatrix} = 0$$

1 2 3 4 5

1) $-i_1 + \dfrac{u_1}{R} + \dfrac{u_1 - r i_V}{2R} + \dfrac{u_1 - u_2}{R} = 0$

2) $-i_2 + \dfrac{u_2}{2R} + \dfrac{u_2 - r i_V}{R} + \dfrac{u_2 - u_1}{R} = 0$

3) $i_V = \dfrac{u_1 - u_2}{R}$

pl. $\underline{\underline{G}}: \begin{pmatrix} i_1 \\ i_2 \end{pmatrix} = \underline{\underline{G}} \begin{pmatrix} u_1 \\ u_2 \end{pmatrix} \leftarrow$ "forrásos"

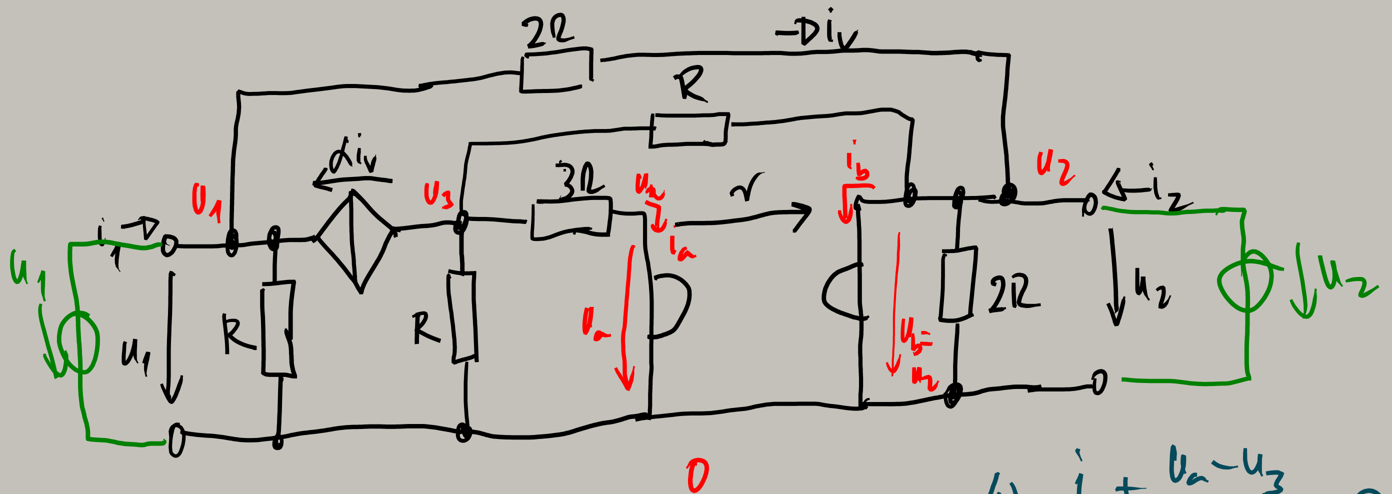
$$\begin{pmatrix} \quad \end{pmatrix}\begin{pmatrix} i_1 \\ i_2 \\ i_V \end{pmatrix} = \begin{pmatrix} \quad \end{pmatrix}\begin{pmatrix} u_1 \\ u_2 \end{pmatrix}$$

2 4 5

$(-1)\cdot \xi_1 \quad (-1)\ \xi_3$

$\underline{\underline{G}}$

$$\begin{pmatrix} \quad \end{pmatrix} = \begin{pmatrix} \quad \end{pmatrix}\begin{pmatrix} \quad \end{pmatrix}$$



$\underline{\underline{G}} = ?$ $\qquad \begin{pmatrix} i_1 \\ i_2 \end{pmatrix} = \underline{\underline{G}} \cdot \begin{pmatrix} u_1 \\ u_2 \end{pmatrix}$

$r = 1{,}75\,k\Omega;$ $\quad \alpha = 0{,}5$

$R = 1{,}8\,k\Omega;$

1) $-i_1 + \frac{u_1}{R} - \alpha i_v + \frac{u_1 - u_2}{2R} = 0$

2) $-i_2 + \frac{u_2}{2R} + i_b + \frac{u_2 - u_1}{2R} + \frac{u_2 - u_3}{R} = 0$

3) $\alpha \cdot i_v + \frac{u_3}{R} + \frac{u_3 - u_a}{3R} + \frac{u_3 - u_2}{R} = 0$

4) $i_a + \frac{u_a - u_3}{3R} = 0$

5) $u_a = -r \cdot i_b$

6) $u_2 = r \cdot i_a$

7) $i_v = \frac{u_1 - u_2}{2R}$

$$\begin{array}{c} \begin{array}{ccccccc} i_1 & i_2 & u_3 & u_4 & i_a & i_b & i_v \end{array} \\ \begin{pmatrix} 1 & . & . & . & . & . & \alpha \\ . & 1 & 1/R & . & . & -1 & . \\ . & . & 7/3R & -\frac{1}{R} & . & . & \alpha \\ . & . & -\frac{1}{3R} & \frac{1}{3R} & 1 & . & . \\ . & . & . & 1 & . & r & . \\ . & . & . & . & r & . & . \\ . & . & . & . & . & . & 2R \end{pmatrix} \end{array} \begin{pmatrix} \\ \\ \\ \\ \\ \\ \\ \end{pmatrix} =$$

$$= \begin{pmatrix} \frac{3}{2R} & -\frac{1}{2R} \\ -\frac{1}{2R} & \frac{3}{2R} \\ . & \frac{1}{R} \\ . & . \\ . & . \\ . & 1 \\ 1 & -1 \end{pmatrix} \cdot \begin{pmatrix} u_1 \\ u_2 \end{pmatrix}$$