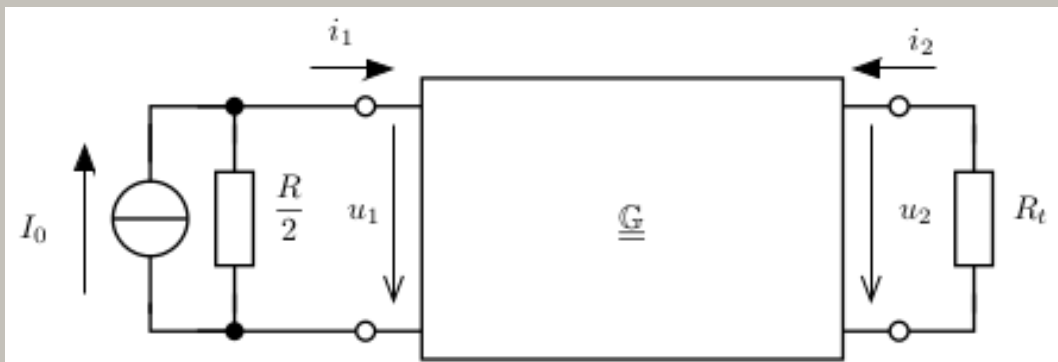


G. gyártólat - Két kárpú általánosítása - helyettesítő kárpú

1)



$I_0 = 10 \text{ mA}; R = 4 \text{ k}\Omega$

$G = \begin{pmatrix} 1 \\ L \end{pmatrix} \cdot \begin{pmatrix} 2 & -1 \\ -1 & 3 \end{pmatrix}$

a) $G \rightarrow \Pi$ helyettesítő kárpú.

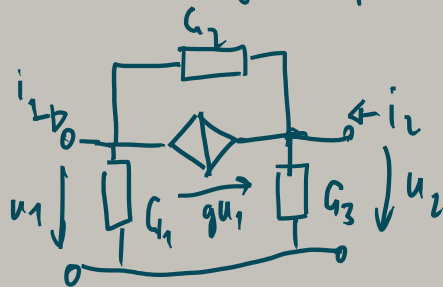
b) $R_L = ?$ $P_{\text{max}} = ?$

\hookrightarrow hely. kárpú ill. mut. működés

a) admittancia kárpú:

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

Π -hely. kárpú (szokásos van)



$i_1 = G_{11} \cdot u_1 + G_{12} \cdot u_2$

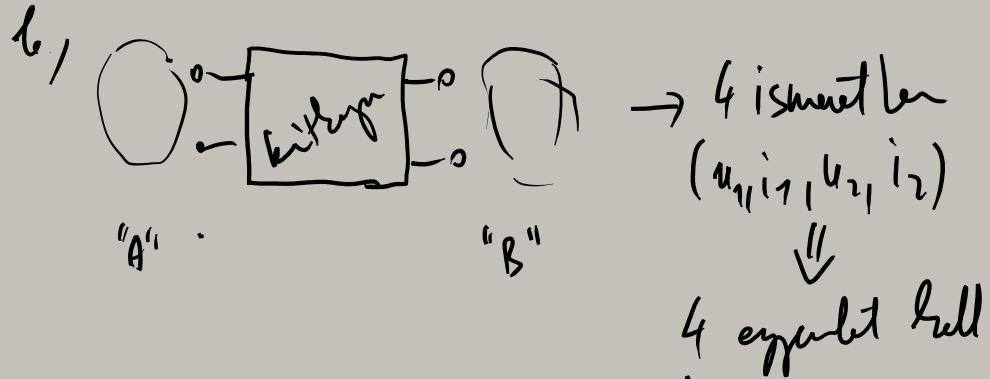
$i_2 = G_{21} \cdot u_1 + G_{22} \cdot u_2$

$\Leftrightarrow \begin{cases} i_1 = (G_1 + g + G_2) u_1 - G_2 u_2 \\ i_2 = -(g + G_2) u_1 + (G_2 + G_3) u_2 \end{cases}$

$\left. \begin{aligned} -i_1 + G_1 \cdot u_1 + g \cdot u_1 + G_2(u_1 - u_2) &= 0 \\ -i_2 - g u_1 + G_3 \cdot u_2 + G_2(u_2 - u_1) &= 0 \end{aligned} \right\}$

összevetés alapján :

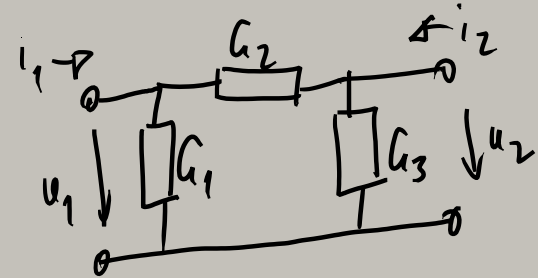
$$\left. \begin{aligned} G_{11} &= G_1 + G_2 + g \\ G_{12} &= -G_2 \\ G_{21} &= -(g + G_2) \\ G_{22} &= G_2 + G_3 \end{aligned} \right\} \begin{pmatrix} G_1 & G_2 & G_3 & g \\ 1 & 1 & \cdot & 1 \\ \cdot & -1 & \cdot & \cdot \\ \cdot & -1 & \cdot & -1 \\ \cdot & 1 & 1 & \cdot \end{pmatrix} \begin{pmatrix} G_1 \\ G_2 \\ G_3 \\ g \end{pmatrix} = \begin{pmatrix} G_{11} \\ G_{12} \\ G_{21} \\ G_{22} \end{pmatrix} = \begin{pmatrix} 2/R \\ -1/R \\ -1/R \\ 3/R \end{pmatrix}$$



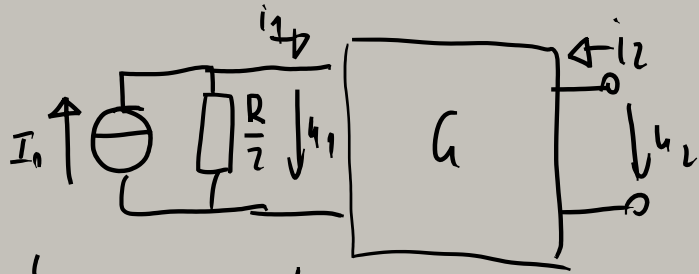
- 2 egyenlet - R aránysági képlet
- 1 egyenlet primer oldali leírás
- 1 - (-) behatás - - " -

$$\begin{aligned} G_1 &= 0,25 \text{ mS} & G_3 &= 0,5 \text{ mS} \\ G_2 &= 0,25 \text{ mS} & g &= 0 \end{aligned}$$

$G_{12} = G_{21} \Rightarrow$ reciproka \Rightarrow hely. kép
(π -tag)
nem ha sor. forrás



pl. $\underline{K} \rightarrow \underline{G} \Rightarrow T$ -kép elemét



$$-I_0 + \frac{u_1}{R/2} + i_1 = 0 \quad (1)$$

$$(3) \quad i_1 = \frac{2}{R} u_1 - \frac{1}{R} u_2$$

$$(4) \quad i_2 = -\frac{1}{R} u_1 + \frac{3}{R} u_2$$

$$U_N = U_T = 3,6364 \text{ V}$$

$$i_{rz} = I_N = -2,5 \text{ mA}$$

$$R_B = \frac{U_T}{-I_N} = 1,4545 \text{ k}\Omega$$

R_B fehlend sind initial behaupten für generator

$$\rightarrow \left. \begin{array}{l} \times \\ \downarrow u_2 = U_N \end{array} \right\} i_2 = 0 \quad (2/a)$$

$$\rightarrow \left. \begin{array}{l} \leftarrow i_{rz} \\ \downarrow u_2 = 0 \end{array} \right\} i_2 = i_{rz} \quad (2/b)$$

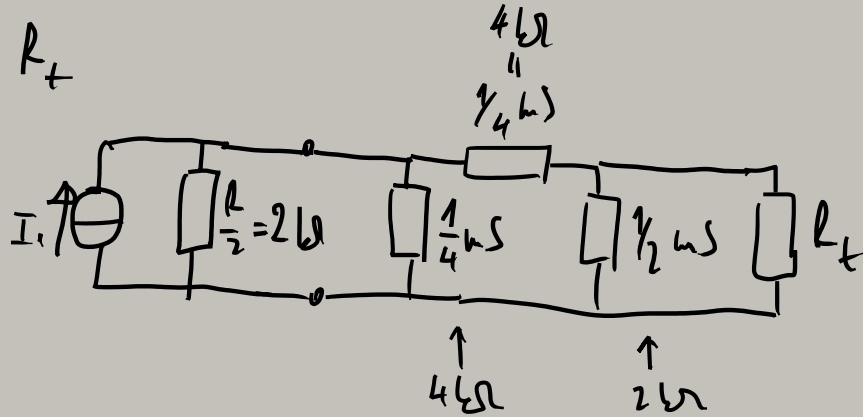
sol.

$$\left. \begin{array}{l} \frac{2}{R} u_1 + i_1 = I_0 \\ i_2 = 0 \\ -\frac{2}{R} u_1 + i_1 + \frac{1}{R} u_2 = 0 \\ \frac{1}{R} u_1 - \frac{3}{R} u_2 + i_2 = 0 \end{array} \right\} \begin{array}{l} \begin{pmatrix} \frac{2}{R} & 1 & \cdot & \cdot \\ \cdot & \cdot & \cdot & 1 \\ -\frac{2}{R} & 1 & \frac{1}{R} & \cdot \\ \frac{1}{R} & \cdot & -\frac{3}{R} & 1 \end{pmatrix} \begin{pmatrix} u_1 \\ i_1 \\ u_2 \\ i_2 \end{pmatrix} = \begin{pmatrix} I_0 \\ 0 \\ 0 \\ 0 \end{pmatrix} \end{array}$$

$$\underline{rz}: \left. \begin{array}{l} \frac{2}{R} u_1 + i_1 = I_0 \\ u_2 = 0 \\ -\frac{2}{R} u_1 + i_1 + \frac{1}{R} u_2 = 0 \\ \frac{1}{R} u_1 - \frac{3}{R} u_2 + i_2 = 0 \end{array} \right\} \begin{array}{l} \begin{pmatrix} \frac{2}{R} & 1 & \cdot & \cdot \\ \cdot & \cdot & 1 & \cdot \\ -\frac{2}{R} & 1 & \frac{1}{R} & \cdot \\ \frac{1}{R} & \cdot & -\frac{3}{R} & 1 \end{pmatrix} \begin{pmatrix} u_1 \\ i_1 \\ u_2 \\ i_2 \end{pmatrix} = \begin{pmatrix} I_0 \\ 0 \\ 0 \\ 0 \end{pmatrix} \end{array}$$

$$R_t = R_B \quad P_{\max} = \frac{U_t^2}{4R_B} = 2,2728 \text{ mW}$$

teknisches R_t



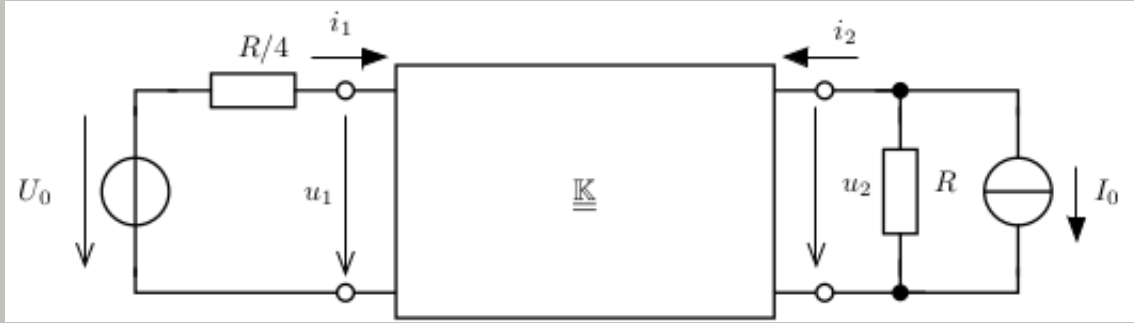
AMF $U_{\eta, I_{\eta}}$ a hely. kisp. alapjén

hely. kisp. alapjén
 R_t "kiszáras" megfont.

$$R_B = \frac{4}{\frac{1}{2} \left((2 \times 4) + 4 \right) \times 2} = \frac{16}{3} \times 2 = \frac{32}{3} = \frac{16}{\frac{3}{2} + 2}$$

$$= \frac{32/2}{\frac{22}{3}} = \frac{32}{22} \approx 1,4545$$

2.)



$R = 100\Omega; I = 0,2A; U_0 = 8V$

$K = \begin{pmatrix} 5/R & 0 \\ -0,5 & 2R \end{pmatrix}$

Rettkapcsolás és áramforrás

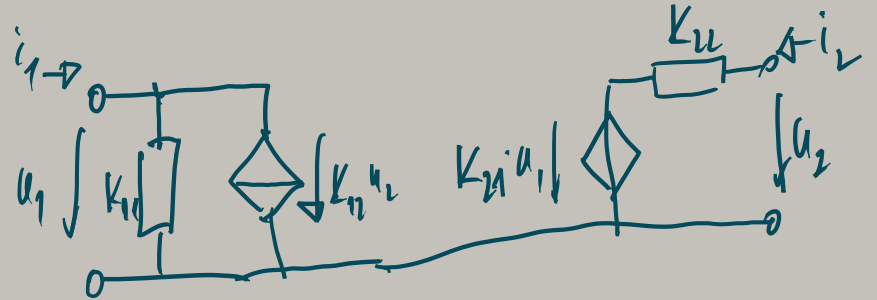
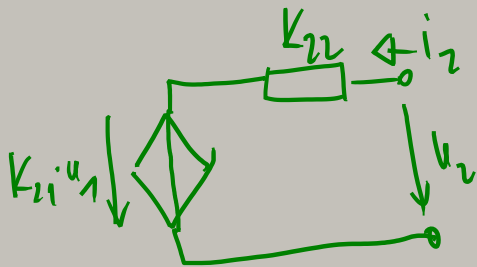
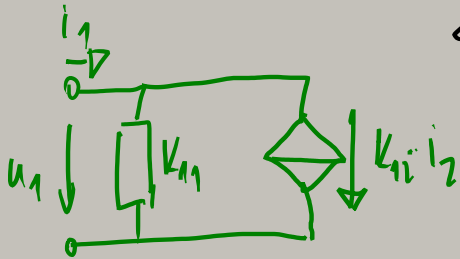
AMF → egyszerűen "mátrika"-val (matematikai megközelítés)

hly.kép: → terméketes helyettesítő kép

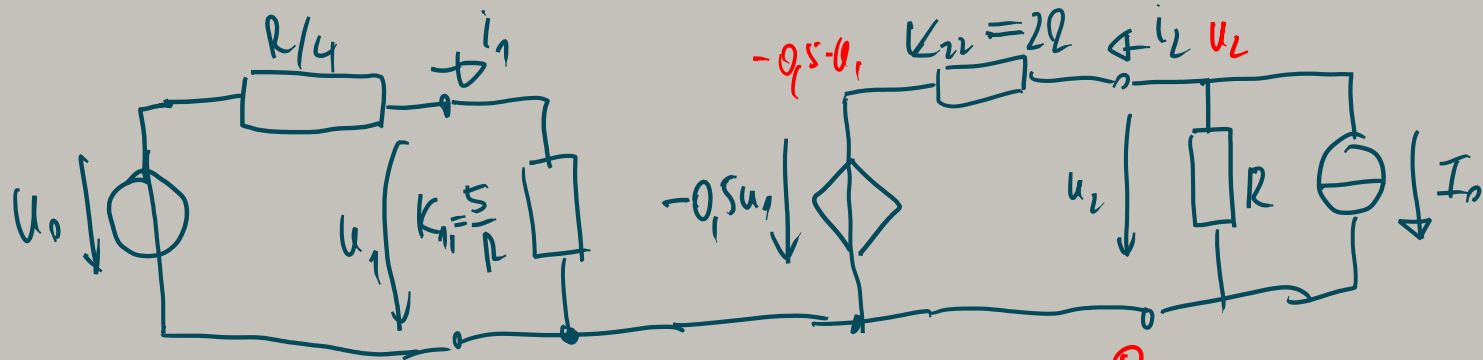
$\begin{pmatrix} i_1 \\ u_2 \end{pmatrix} = \begin{pmatrix} K_{11} & K_{12} \\ K_{21} & K_{22} \end{pmatrix} \begin{pmatrix} u_1 \\ i_2 \end{pmatrix}$

$i_1 = K_{11} u_1 + K_{12} i_2$

$u_2 = K_{21} u_1 + K_{22} i_2$



ha $K_{12} = 0 \Rightarrow \text{diode} \Rightarrow \begin{pmatrix} i \\ u \end{pmatrix}$



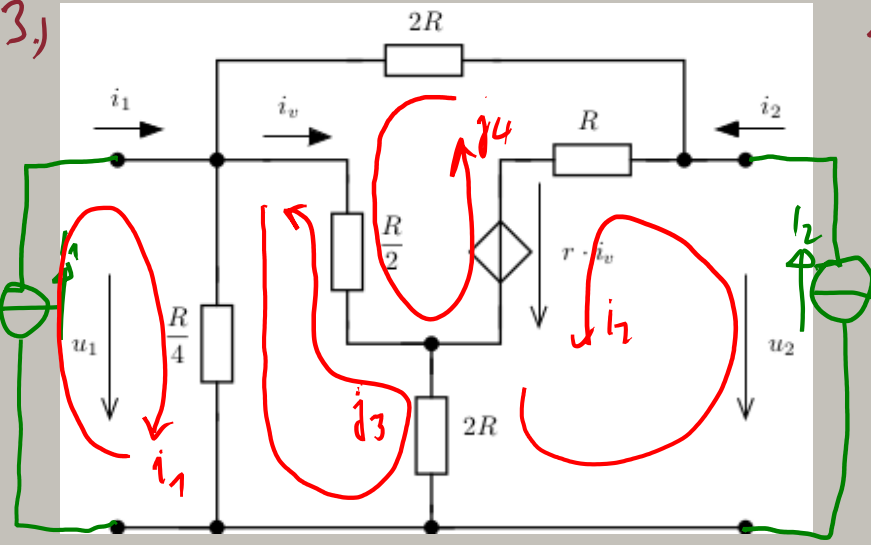
$$u_1 = \frac{R/5}{R/5 + R/4} \cdot u_0 = \frac{5u_0}{9}$$

$$i_1 = \frac{u_0}{\frac{R}{5} + \frac{R}{4}} = \frac{u_0}{\frac{9R}{20}} = \frac{20u_0}{9R}$$

$$\frac{u_2}{R} + \frac{u_2 - (-0.5u_1)}{2R} + I_0 = 0 \Rightarrow u_2 = \dots$$

$$I_2 = \frac{u_2 - (-0.5u_1)}{2R} = \dots$$

3.)



Matricával meg az R karakterisztikát!

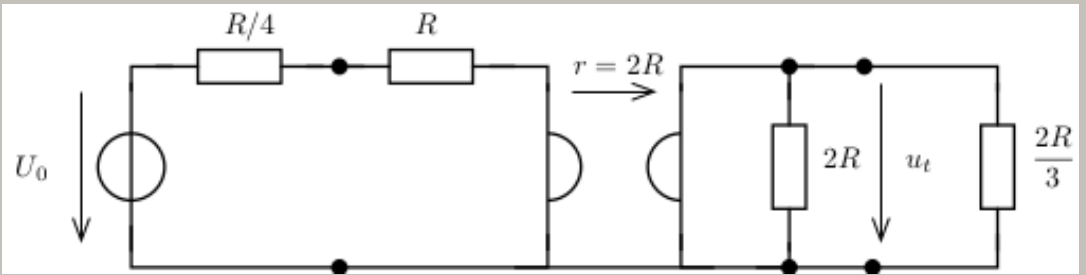
- szimbolikus
 - numerikus módszer
- ($r = 0,5 \Omega$; $R = 2 \Omega$)

u_1, u_2, i_v, j_3, j_4

$$\left. \begin{aligned}
 i_1: & -u_1 + \frac{R}{4} \cdot (i_1 + j_3) = 0 \\
 i_2: & -u_2 + R(i_2 - j_4) + r \cdot i_v + 2R(i_2 - j_3) = 0 \\
 j_3: & \frac{R}{4} \cdot (j_3 + i_1) + 2R(j_3 - i_2) + \frac{R}{2} (j_3 - j_4) = 0 \\
 j_4: & 2R \cdot j_4 + \frac{R}{2} \cdot (j_4 - j_3) - r \cdot i_v + R(j_4 - i_2) = 0 \\
 i_v = & j_4 - j_3
 \end{aligned} \right\}$$

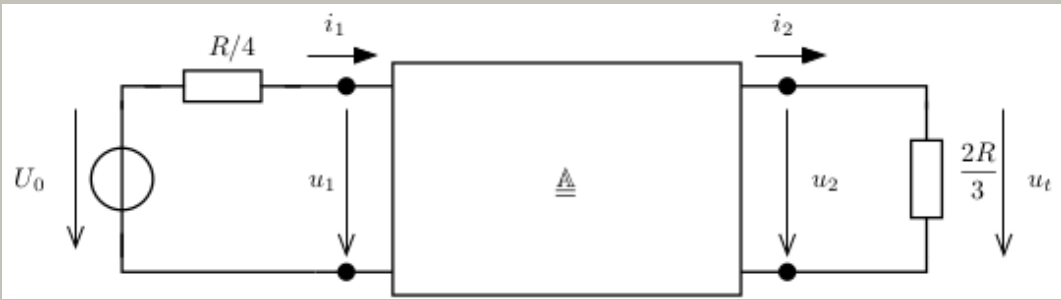
$$R = \begin{pmatrix} \frac{R(17R-4r)}{3(25R-6r)} & \frac{R(15R-4r)}{3(25R-6r)} \\ \frac{5R^2}{25R-6r} & -\frac{R(-25R+12r)}{25R-6r} \end{pmatrix} = \begin{pmatrix} \frac{64}{141} & \frac{56}{141} \\ \frac{20}{47} & \frac{88}{47} \end{pmatrix}$$

41.

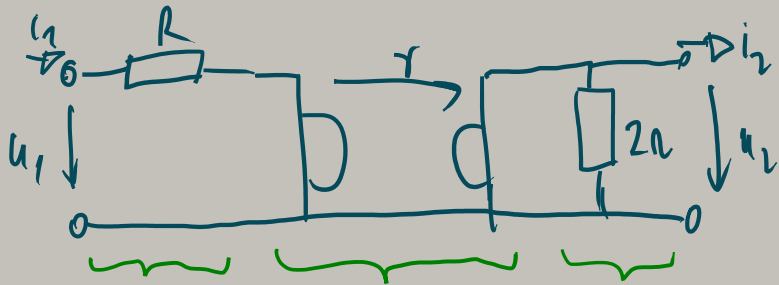


$R = 5 \text{ k}\Omega; U_0 = 10 \text{ V}$

$u_t = ?$



Oldjukt meg az előző feladatot
lánc karakterisztikával!

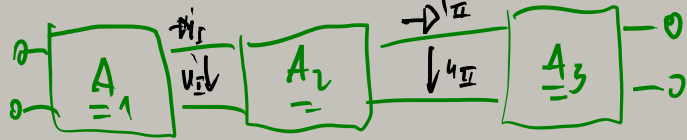


← lánc karakterisztikához fontos az utolsó feladat irány

$$R = 2R$$

$$\begin{pmatrix} u_1 \\ i_1 \end{pmatrix} = \begin{pmatrix} A \\ \underline{\quad} \end{pmatrix} \cdot \begin{pmatrix} u_2 \\ i_2 \end{pmatrix}$$

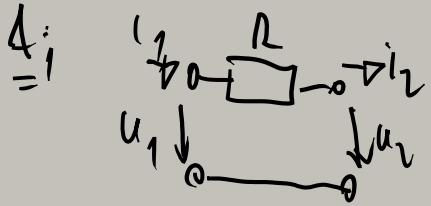
$$\begin{pmatrix} u_2 \\ i_2 \end{pmatrix}$$



$$\underline{A} = \underline{A}_1 \cdot \underline{A}_2 \cdot \underline{A}_3$$

$$\begin{pmatrix} u_1 \\ i_1 \end{pmatrix} = \underline{A}_1 \cdot \begin{pmatrix} u_{II} \\ i_{II} \end{pmatrix} = \underline{A}_1 \cdot \left(\underline{A}_2 \cdot \begin{pmatrix} u_{III} \\ i_{III} \end{pmatrix} \right) = \underline{A}_1 \cdot \left(\underline{A}_2 \cdot \left(\underline{A}_3 \cdot \begin{pmatrix} u_2 \\ i_2 \end{pmatrix} \right) \right) =$$

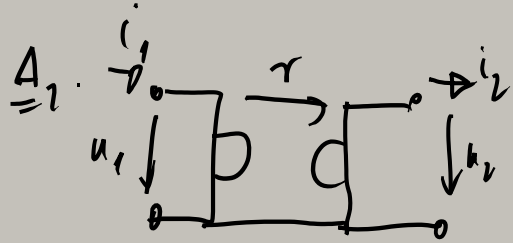
$$= \underline{A}_1 \cdot \underline{A}_2 \cdot \underline{A}_3 \cdot \begin{pmatrix} u_2 \\ i_2 \end{pmatrix}$$



$$\left. \begin{aligned} i_1 &= i_2 \\ u_1 &= u_2 + i_2 R \end{aligned} \right\} \begin{aligned} u_1 &= 1 \cdot u_2 + R \cdot i_2 \\ i_1 &= 0 \cdot u_2 + 1 \cdot i_2 \end{aligned}$$

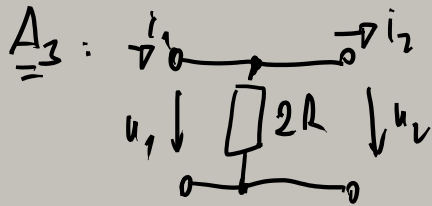
$$\underline{A}_1 = \begin{pmatrix} 1 & R \\ 0 & 1 \end{pmatrix}$$

$$\begin{pmatrix} u_1 \\ i_1 \end{pmatrix} = \underline{A}_1 \cdot \begin{pmatrix} u_2 \\ i_2 \end{pmatrix}$$



$$\left. \begin{aligned} u_1 &= r \cdot i_2 \\ u_2 &= r i_1 \end{aligned} \right\} \begin{aligned} u_1 &= r \cdot i_2 \\ i_1 &= \frac{1}{r} \cdot u_2 \end{aligned}$$

$$\underline{A}_2 = \begin{pmatrix} 0 & r \\ \frac{1}{r} & 0 \end{pmatrix}$$



$$\left. \begin{aligned} u_1 &= u_2 \\ i_1 &= \frac{1}{2R} u_2 + i_2 \end{aligned} \right\} \underline{A}_3 = \begin{pmatrix} 1 & 0 \\ \frac{1}{2R} & 1 \end{pmatrix}$$

$$\underline{A} = \underline{A}_1 \cdot \underline{A}_2 \cdot \underline{A}_3 = \begin{pmatrix} 1 & R \\ 0 & 1 \end{pmatrix} \cdot \begin{pmatrix} 0 & r \\ \frac{1}{r} & 0 \end{pmatrix} \cdot \begin{pmatrix} 1 & 0 \\ \frac{1}{2R} & 1 \end{pmatrix} = \begin{pmatrix} \frac{r}{2R} + \frac{R}{r} & r \\ \frac{1}{r} & 0 \end{pmatrix} = \begin{pmatrix} \frac{r^2 + 2R^2}{2Rr} & r \\ \frac{1}{r} & 0 \end{pmatrix}$$

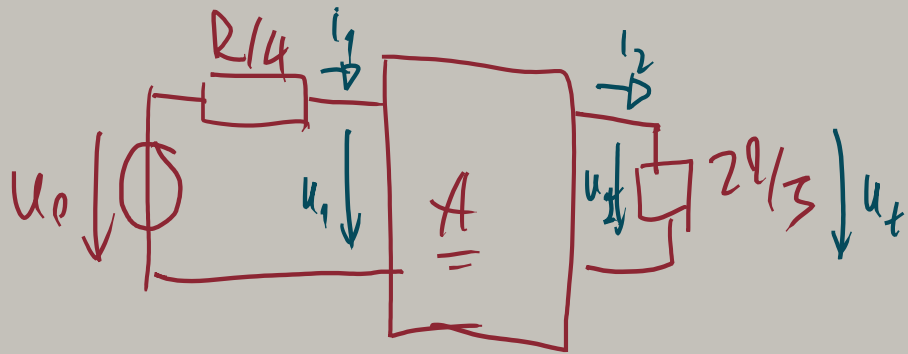
$r = 2R$

$$\underline{A} = \begin{pmatrix} \frac{3}{2} & 2R \\ \frac{1}{2R} & 0 \end{pmatrix}$$

$$\begin{pmatrix} \frac{r}{2R} & r \\ \frac{1}{r} & 0 \end{pmatrix}$$

$$\frac{r^2 + 2R^2}{2Rr} = \frac{(2R)^2 + 2R^2}{2R \cdot 2R} = \frac{6R^2}{4R^2} = \frac{3}{2}$$

- kann sich bei Aufgaben mit Hinterrufen



$$(1) \quad u_1 = u_0 - i_1 \cdot (R/4)$$

$$(2) \quad u_2 = i_2 \cdot \frac{2R}{3}$$

$$(3) \quad u_1 = \frac{3}{2} u_2 + 2R \cdot i_2$$

$$(4) \quad i_1 = \frac{1}{2R} u_2$$

$$u_t = u_2$$

\Leftrightarrow

$$\begin{pmatrix} u_1 \\ i_1 \\ u_2 \\ i_2 \end{pmatrix} \begin{pmatrix} R/4 & \cdot & \cdot & \cdot \\ \cdot & \cdot & 1 & -\frac{2R}{3} \\ \cdot & \cdot & -\frac{3}{2} & -2R \\ \cdot & -1 & -\frac{1}{2R} & \cdot \end{pmatrix} \begin{pmatrix} u_1 \\ i_1 \\ u_2 \\ i_2 \end{pmatrix} = \begin{pmatrix} u_0 \\ 0 \\ 0 \\ 0 \end{pmatrix}$$