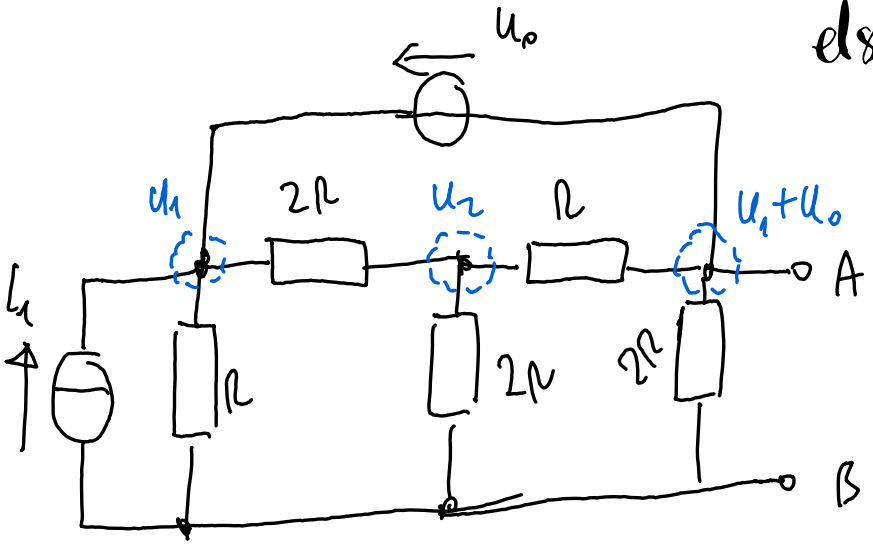
A 03.10-i gyakorlat feladata (amit a táblán elszámoltam)



$U_0 = 10\,V$

$I_1 = 3\,mA$

$R = 1\,k\Omega$

csomópontok:

$$\textcircled{1}\quad -I_1 + \frac{U_1}{R} + \frac{U_1 - U_2}{2R} + \frac{(U_1+U_0) - U_2}{R} + \frac{U_1+U_0}{2R} = 0$$

$$\textcircled{2}\quad \frac{U_2}{2R} + \frac{U_2 - U_1}{2R} + \frac{U_2 - (U_1+U_0)}{R} = 0$$

$2R\cdot\textcircled{1} \rightarrow \quad 6U_1 - 3U_2 = -3U_0 + 2RI_1 = -30 + 6 = -24$

$2R\cdot\textcircled{2} \rightarrow \quad -3U_1 + 4U_2 = 2U_0 = 20$

$\Rightarrow U_1 = -2{,}4\,V$

$U_2 = 3{,}2$

$$U_{ki} = U_1 + U_0 \approx 7{,}6\,V$$

üresjárási feszültség (A–B közötti) → $U_{AB} = 0$

① helyett ③ $\boxed{U_1 + U_0 = 0}$

így ③ $U_1 = -U_0 = -10$

② $-3U_1 + 4U_2 = 20$

$\boxed{U_1 = -10\,V \quad U_2 = -2{,}5\,V}$

i_{rt}-hez az ①-et kell felírni, így lesz U_1 és U_2 más ismert

$$i_{rt} + \frac{U_1 + U_0 - U_2}{R} + \frac{U_1 - U_2}{2R} + \frac{U_1}{R} + (-I_1) = 0$$

$$i_{rt} = \frac{-1}{2R}\left(5U_1 - 3U_2 + 2U_0 - 2RI_1\right) = 14{,}25\,mA$$

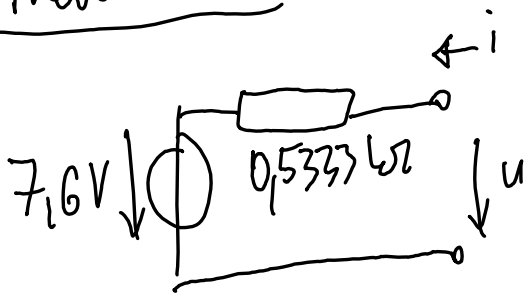
$I_N = -i_{rt} = -14{,}25\,mA$

$U_T = U_{üres} = 7{,}6\,V$

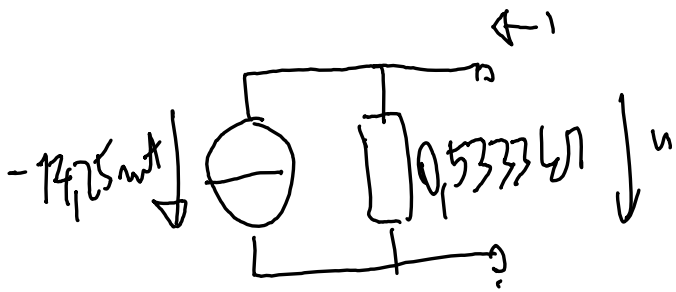
belső ellenállás:

$$R_B = \frac{U_T}{-I_N} = \frac{7{,}6}{14{,}25} = 0{,}5333\,k\Omega$$

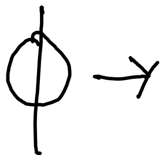
Thevenin-kk.



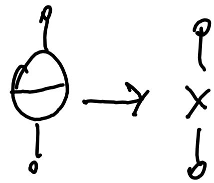
Norton-kk.

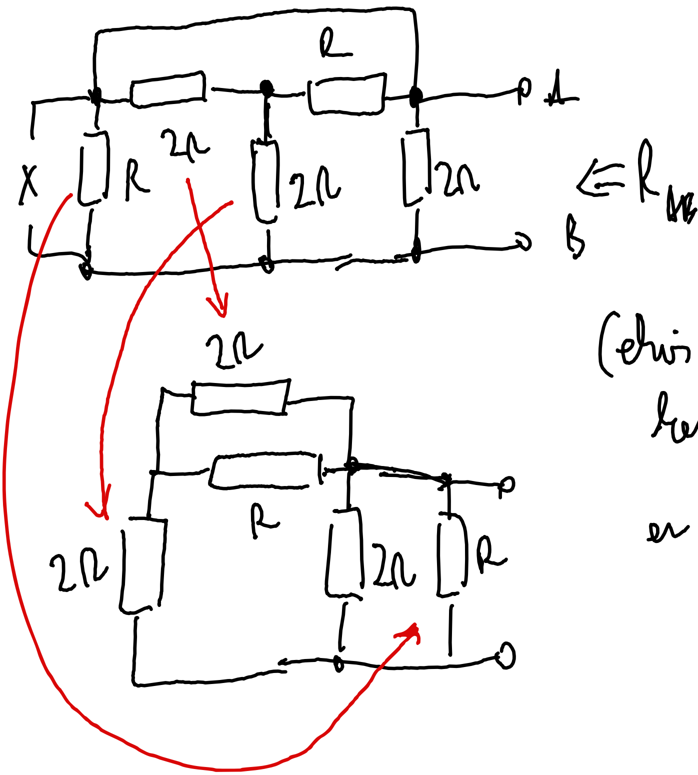


R_B kiszámítása dualizálással:



és





ez átrajzolható (ennek ellenkezőjét állítottam volt :))

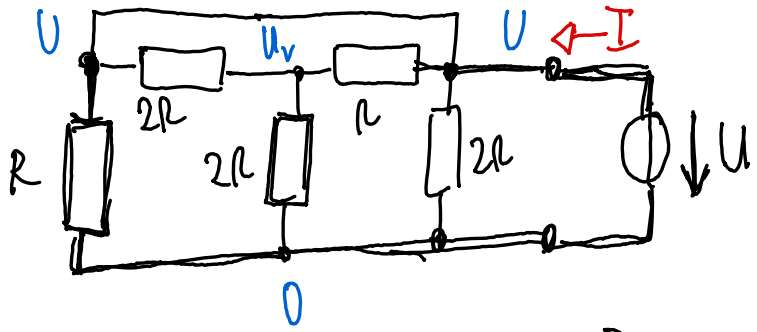
(ekvipotenciális csomópontokra kell figyelni)

ez alapján

$$\left(2R + \underbrace{(R \times 2R)}_{\frac{2R}{3}}\right) \times \underbrace{(R \times 2R)}_{\frac{2R}{3}} = \frac{8R}{3} \times \frac{2R}{3} = \frac{16R}{30} = \frac{8}{15}R$$

$$R_B = \frac{8}{15}\,k\Omega = 0{,}5333\ k\Omega$$

Kirchhoff-féle csomóponti módszer alkalmazásával



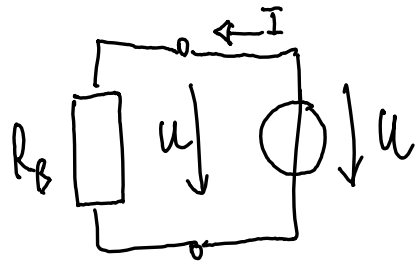
$$\frac{U}{R}+\frac{U-U_V}{2R}+\frac{U-U_V}{R}+\frac{U}{2R}-I=0 \quad \Rightarrow \quad 6U-3U_V=2RI$$

$$\frac{U_V}{2R}+\frac{U_V-U}{2R}+\frac{U_V-U}{R}=0 \quad \Rightarrow \quad -3U+4U_V=0$$

$$U=0{,}5333\cdot RI \quad \text{és} \quad U_V=0{,}4\cdot RI$$

innen $$R_B=\frac{U}{I}=0{,}5333\cdot R$$

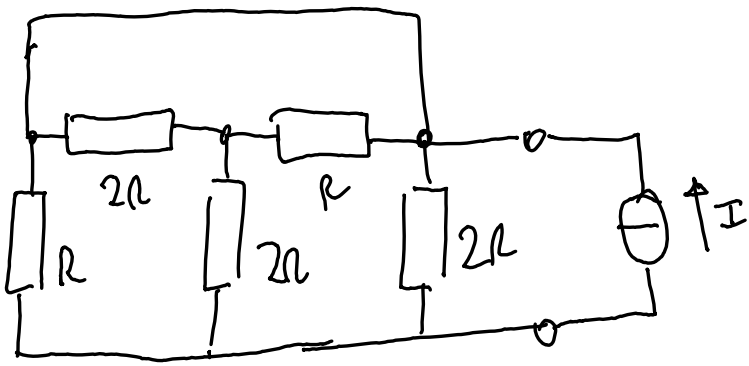
mert



$$U=R_B\cdot I$$

a helyettesítőkép

meg lehetett volna oldani áramforrásra?



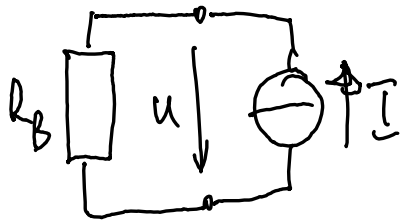
$n=4 \rightarrow$ 3 csp

$b=7$ $b-n+1=4$ hurok, de 3 HÁ kellene

↑

(5R, 1Θ, 1I)

→ mindkét módszerrel azonos bonyolultságú feladat



$u = R_B \cdot I$ alakja adódna R_B