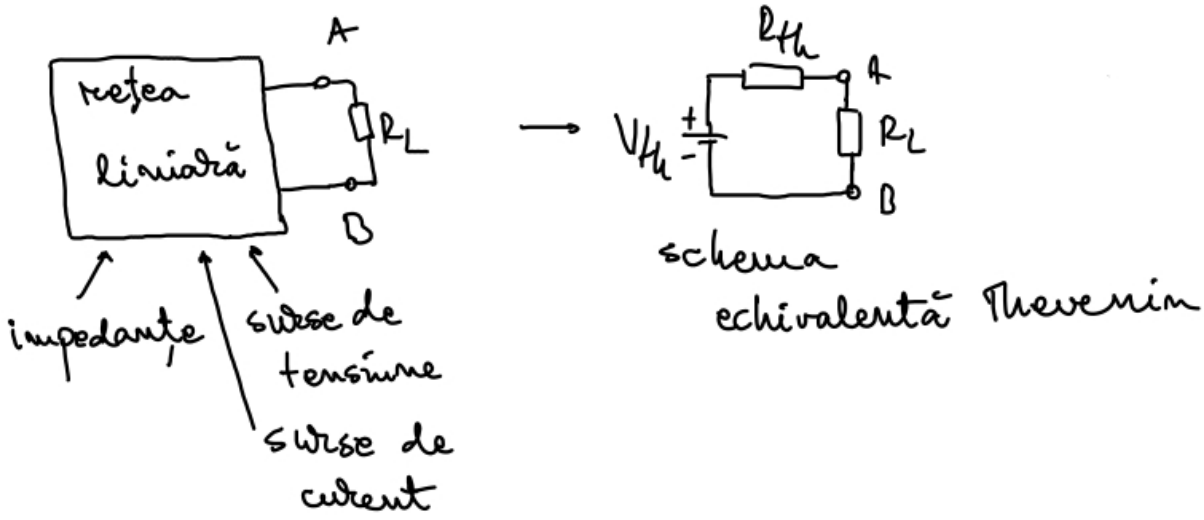
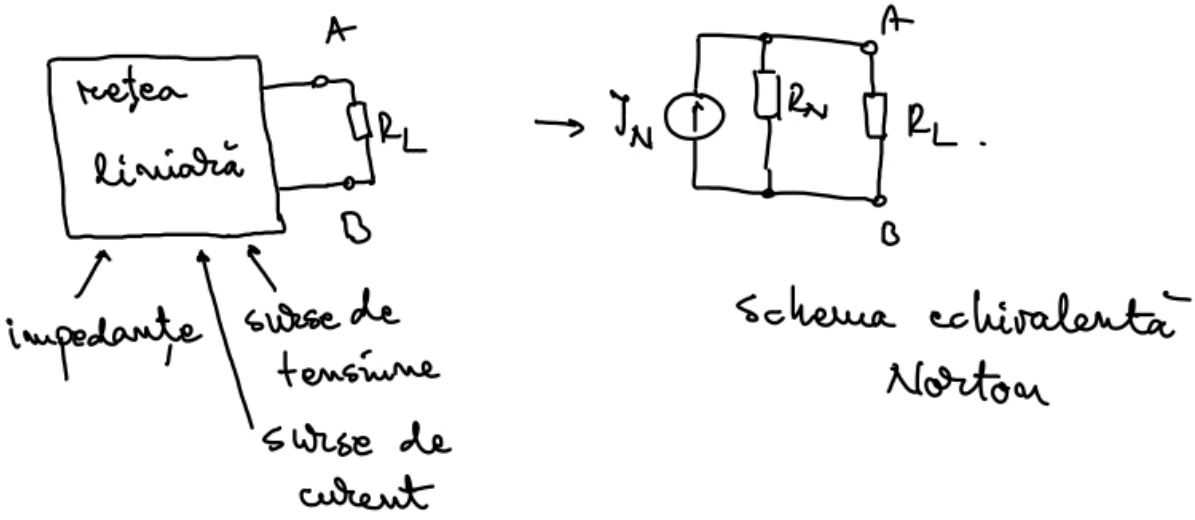
Seminar nr. 2

Teorema lui Thevenin:

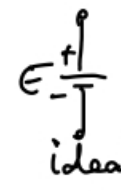


schema echivalentă Thevenin

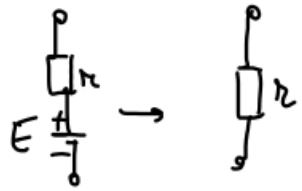
Teorema lui Norton:

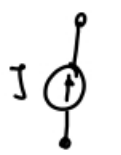


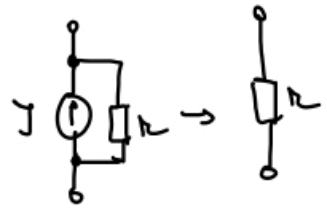
schema echivalentă Norton

Pasivare: sursă de tensiune: 

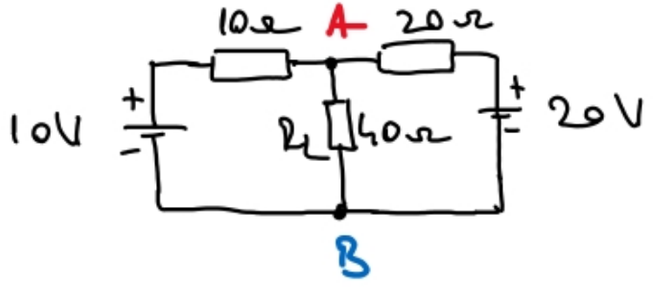
ideală



sursă de curent 

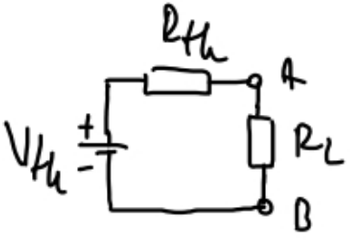


P1 Determinați circuitul echivalent Thevenin pentru schema de mai jos

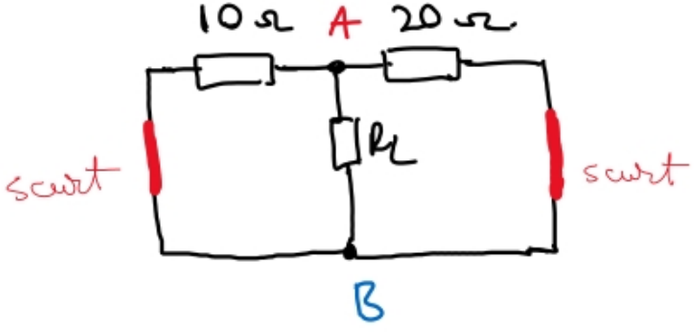


$V_{th} = ?$

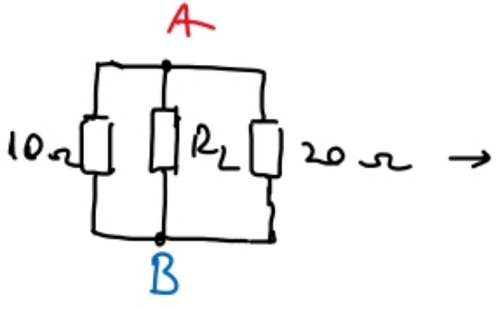
$R_{th} = ?$



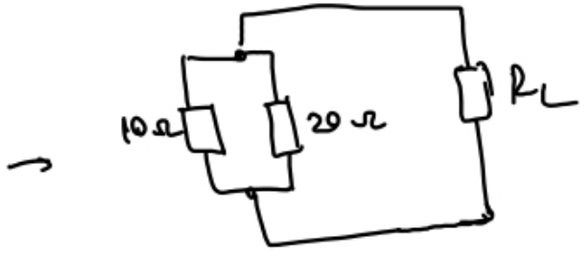
step 1: Pasivăm toate sursele și determinăm R_{th} (în serie cu R_L)



→



→



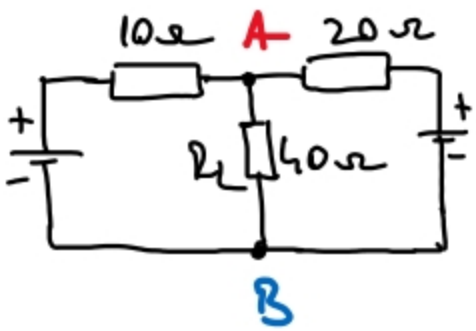
Rezistența în serie cu R_L este

$10\Omega \,||\, 20\Omega$

$$R_p = \frac{R_1 R_2}{R_1 + R_2} = \frac{10 \times 20}{10+20} = \frac{200}{30} = 6.67\Omega$$

$$R_{th} = 6.67\,\Omega$$

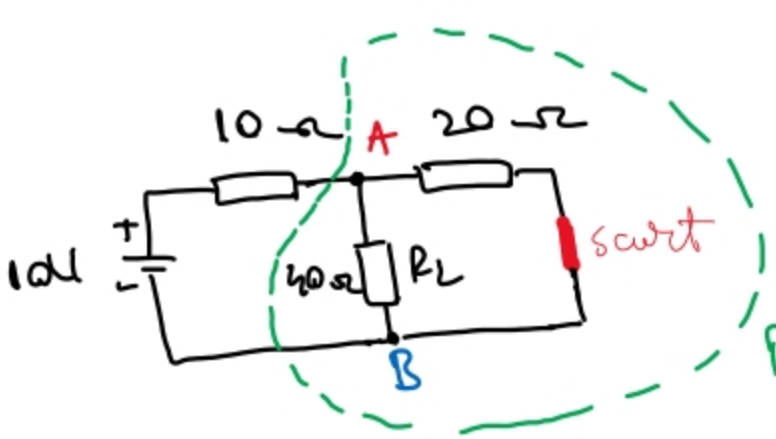
step 2: determinăm U_{AB}

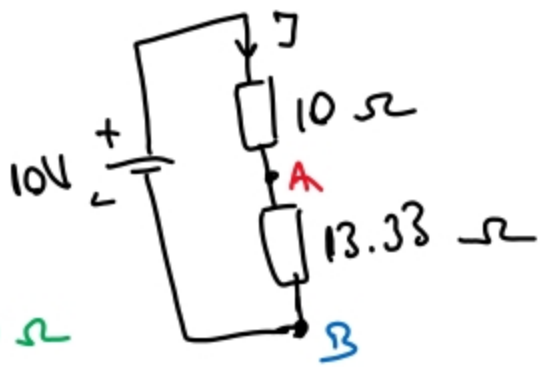


T. superpoziției:

$$U_{AB} = U_{AB}^{E_1} + U_{AB}^{E_2}$$

U_{AB} datorită lui E_1 (păstrăm E_2).





$R_p = 20\Omega \| 40\Omega$

$$R_p = \frac{20 \times 40}{20+40} = \frac{800}{60} = 13.33\,\Omega$$

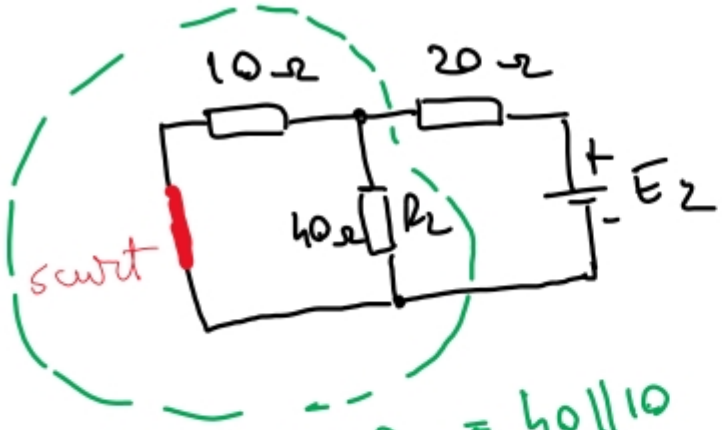
$$U_{AB}^{E_1} = J \times 13.33$$

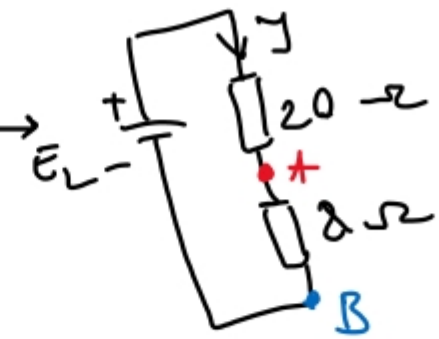
$$10V = J(10 + 13.33)$$

$$\frac{U_{AB}^{E_1}}{10} = \frac{J \times 13.33}{J \times 23.33} \Rightarrow U_{AB}^{E_1} = 10 \times 0.571$$

$$U_{AB}^{E_1} = 5.71V$$

U_{AB} datorită lui E_2 (pasivăm E_1)





$R_p = 40 \| 10$

$$R_p = \frac{40 \times 10}{40 + 10} = \frac{400}{50} = 8\ \Omega$$

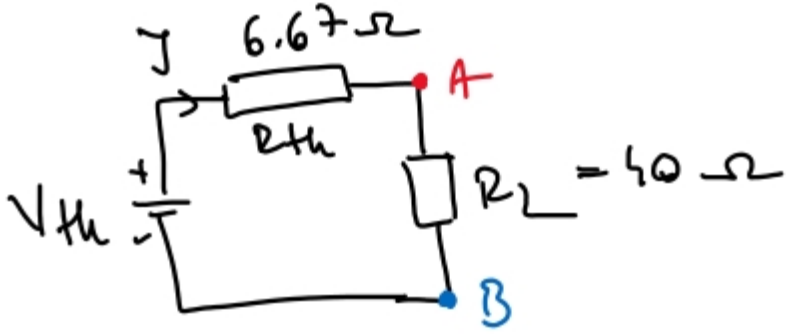
$$20V = J(20 + 8)$$

$$U_{AB}^{E_2} = J \times 8$$

$$\frac{U_{AB}^{E_2}}{20V} = \frac{J \times 8}{J \times 28} \Rightarrow U_{AB}^{E_2} = 20 \times \frac{8}{28}$$

$$U_{AB}^{E_2} = 5.71V$$

$$U_{AB} = U_{AB}^{E_1} + U_{AB}^{E_2} = 5.71 + 5.71 = 11.42V$$



$U_{AB} = R_L \cdot J \Rightarrow$

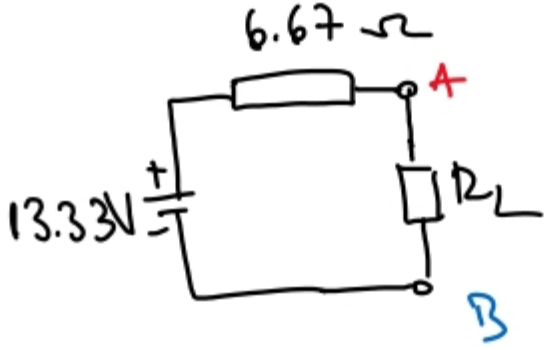
$\Rightarrow J = \frac{U_{AB}}{R_L} = \frac{11.42}{40} = 0.286\,A$

$U_{Rth} = J \cdot R_{th} =$

$= 0.286 \times 6.67 = 1.91\,V$

$V_{th} = U_{Rth} + U_{AB} = 11.42 + 1.91 = 13.33\,V$

Circuitul echivalent Thevenin:



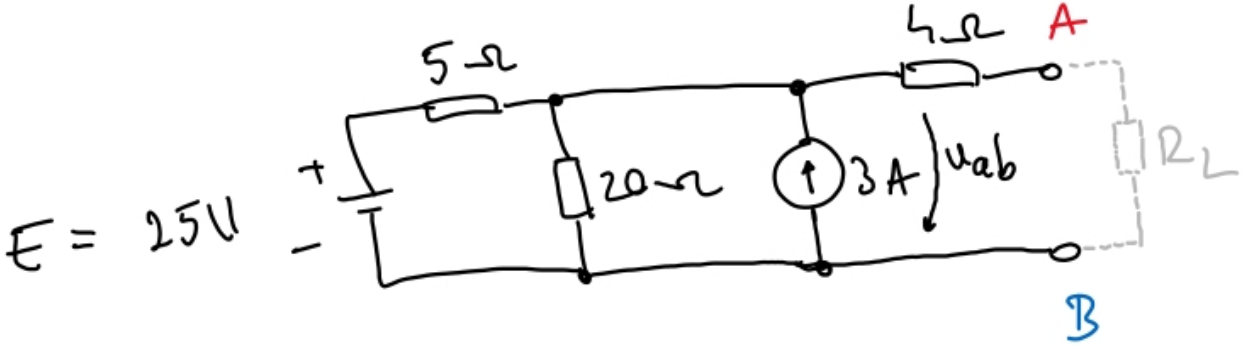
P2. Determinați circuitul echivalent Thevenin pentru schema de mai jos

Metoda alternativă: înlocuim R_L cu ∞ (întrerupere) →

→ mers în gol → $v_{gol} = v_{Th}$

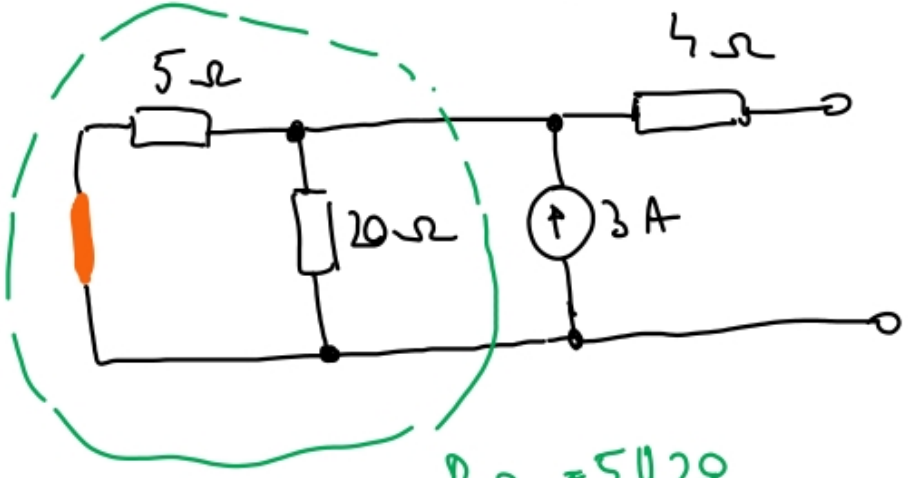
înlocuim R_L cu 0 (scurtcircuit) →

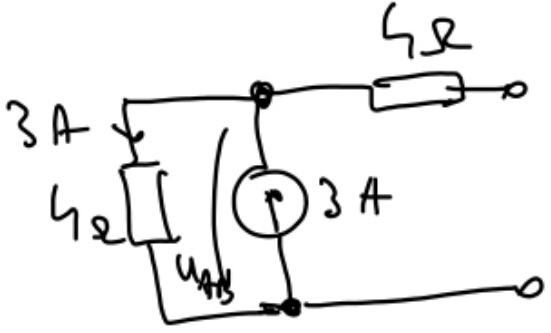
→ mers în scurtcircuit → $I_{sc} \Rightarrow R_{Th}$



$$u_{AB} = u_{gol} = V_{Th} = U_{AB}^{(E)} + U_{AB}^{(3A)}$$

T. superpoziției: (păstrăm E) + punem $R_L = \infty$.



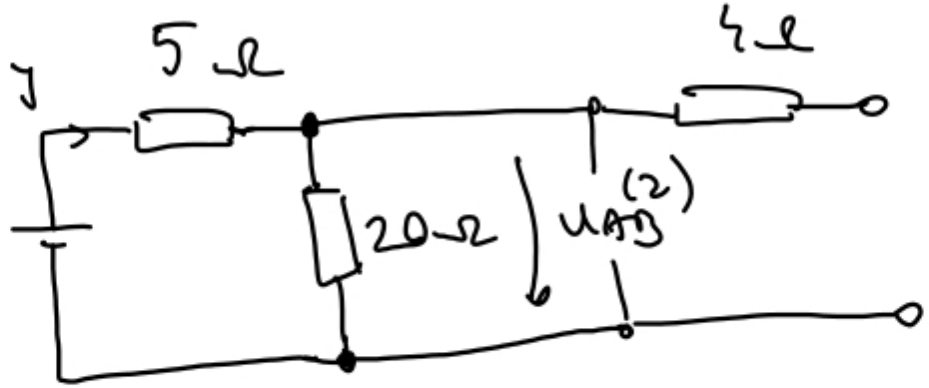


$R_p = 5 \| 20$

$$R_p = \frac{5 \times 20}{5+20} = \frac{100}{25} = 4\,\Omega$$

$$U_{AB}^{(1)} = 4\,\Omega \times 3\,A = 12\,V$$

T. superpoziției (păstrăm 3A)



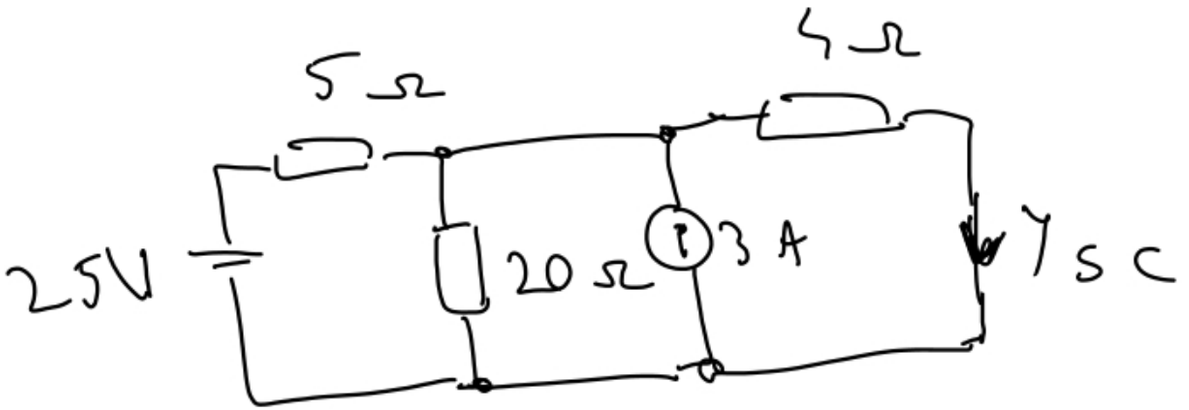
$$E = I\,(5+20)$$

$$U_{AB}^{(2)} = I \cdot 20$$

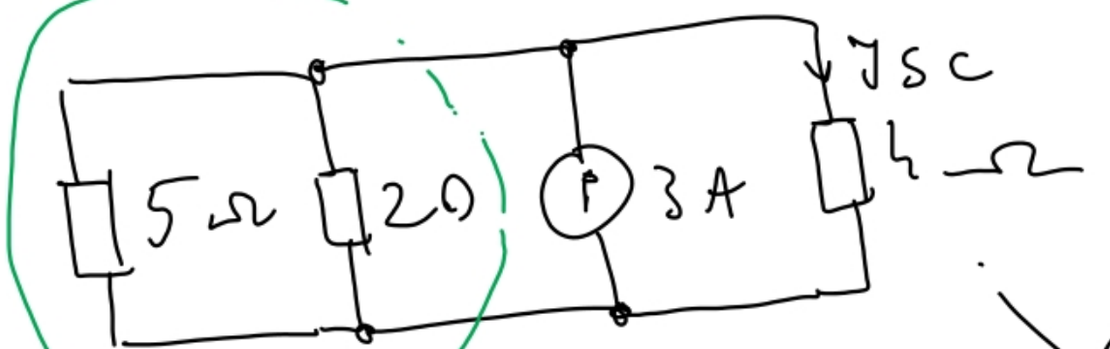
$$\frac{U_{AB}^{(2)}}{25} = \frac{I \cdot 20}{I \cdot 25} \Rightarrow U_{AB}^{(2)} = 20V$$

$$V_{th} = 12V + 20V = 32V$$

Pentru determinarea I_{sc} punem $R_L = 0$.



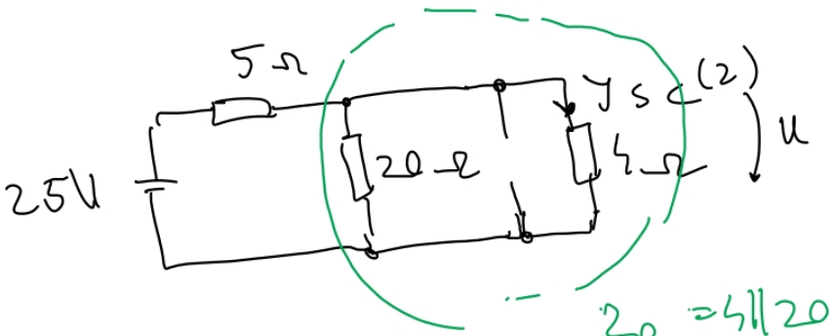
T. superpoziției (pasivăm E)



$R_p = 20 \| 5$

$$I_{sc}^{(1)} = 1.5\,A$$

$$R_p = \frac{20 \cdot 5}{20+5} = \frac{100}{25} = 4\,\Omega$$



$U = 4 \times J_{sc}^{(2)}$

$10 = 4 \times J_{sc}^{(2)}$

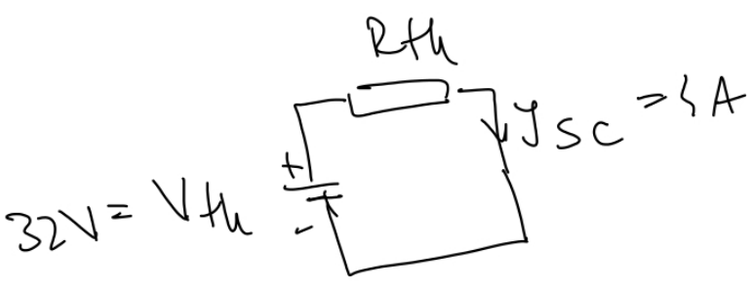
$J_{sc}^{(2)} = \frac{10}{4} = 2.5A$

$R_p = 4 \| 20$

$R_p = \frac{4 \cdot 20}{24} = \frac{80}{24} = 3.33$

$U = 10V$

$J_{sc} = J_{sc}^{(1)} + J_{sc}^{(2)} = 1.5A + 2.5A = 4A$

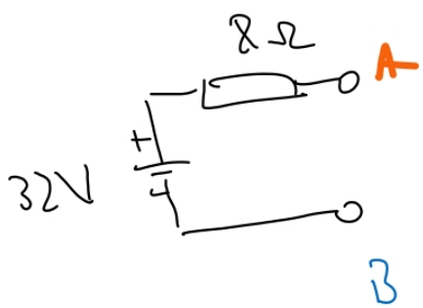


$V_{th} = R_{th} \cdot J_{sc}$

(dacă $R_L = 0$)

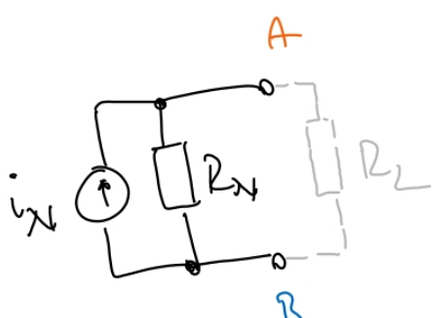
$R_{th} = \frac{V_{th}}{J_{sc}} = \frac{32V}{4A} = 8\Omega$

circuitul echivalent Thevenin



$i_{sc} = 4A$

circuitul echivalent Norton



$R_N = R_{th} = 8\Omega$

$i_N = i_{sc} = 4A$

$V_{th} = i_N \cdot R_{th}$.