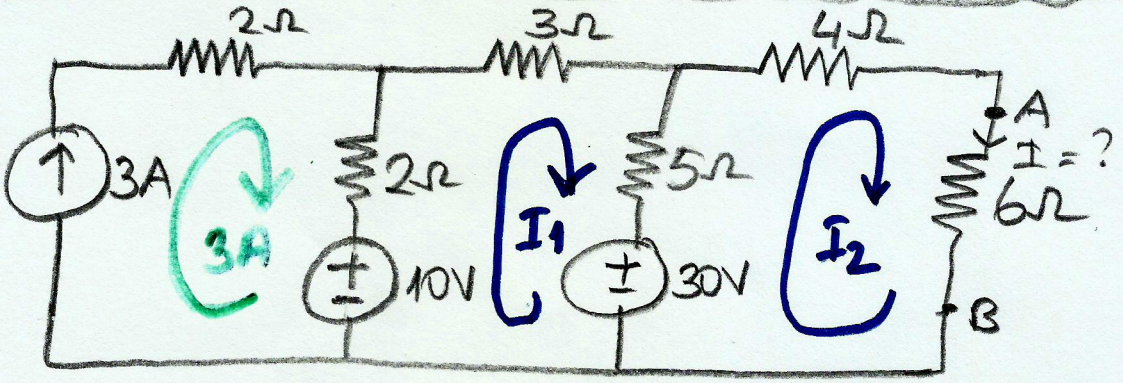
Doç.Dr. Recep Yumurtacı (YTÜ)

Örnek-1 (DC Devre GAY, Thevenin, Süperpozisyon)



6Ω'luk direncin akımını G.A.Y. ile hesaplayınız.

Çözüm

1. Çevre (I_1)

$$(2+3+5)I_1 - 5I_2 - 10 + 30 - 2.3 = 0$$

$$\boxed{10I_1 - 5I_2 = -14}$$ 1. denklem

2. Çevre (I_2)

$$(4+5+6).I_2 - 5I_1 - 30 = 0 \Rightarrow \boxed{-5I_1 + 15I_2 = 30}$$ 2. denklem

$$\begin{bmatrix} 10 & -5 \\ -5 & 15 \end{bmatrix} \cdot \begin{bmatrix} I_1 \\ I_2 \end{bmatrix} = \begin{bmatrix} -14 \\ 30 \end{bmatrix}$$

6Ω'luk direncin akımı $I = I_2 = ?$

$$I = I_2 = \frac{\begin{vmatrix} 10 & -14 \\ -5 & 30 \end{vmatrix}}{\begin{vmatrix} 10 & -5 \\ -5 & 15 \end{vmatrix}} = \frac{10.30 - (-5).(-14)}{10.15 - (-5).(-5)} = \frac{300 - 70}{150 - 25}$$

$$I = I_2 = \frac{230}{125} \Rightarrow \boxed{I = I_2 = 1,84\,A}$$

Örnek2 (DC Devre Thevenin)

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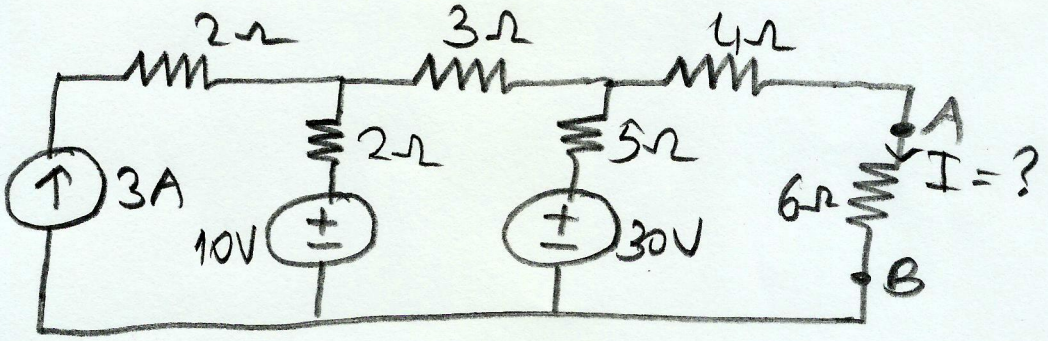
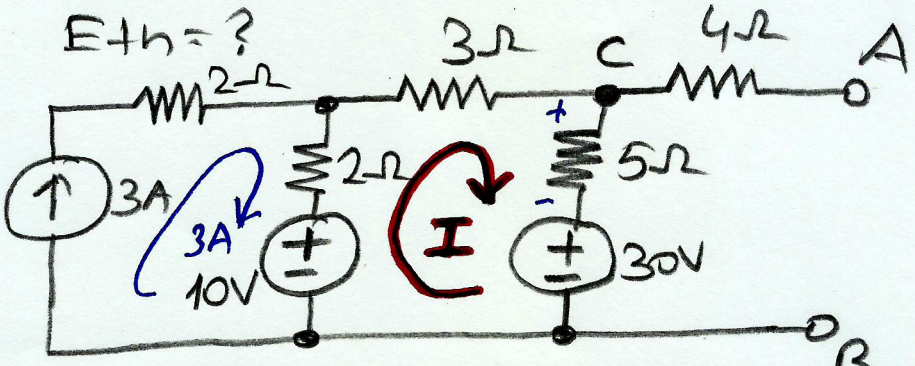


6Ω'luk direncin akımını Thevenin Teoremi ile hesaplayınız.

Çözüm:



4Ω'luk dirençten akım geçmediği için üzerinde gerilim düşümü olmaz. Bu nedenle $V_{AB} = V_{CB} = E_{th}$ olur.

$V_{AB} = V_{CB} = E_{th} = 5.I + 30 \Rightarrow I = ?$

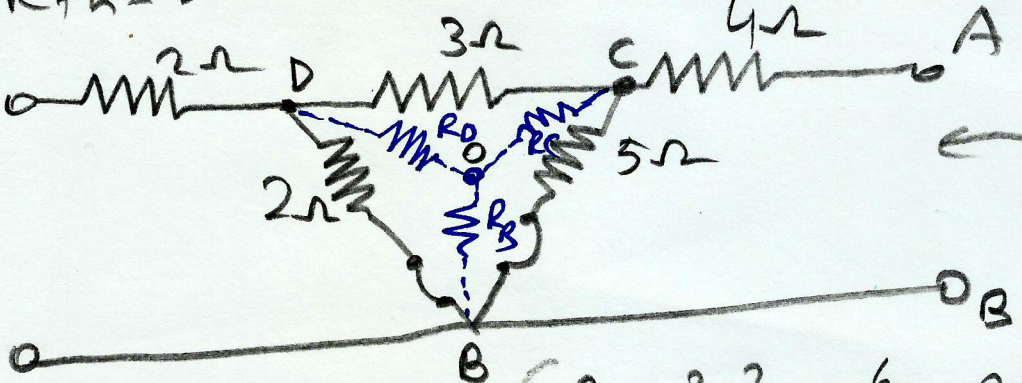
Çevre denklemi

$(2+3+5)I - 2.3 - 10 + 30 = 0$

$10I = -14 \Rightarrow \boxed{I = -1,4A}$

$E_{th} = 5I + 30 = 5(-1,4) + 30 \Rightarrow \boxed{E_{th} = 23V}$

$R_{th} = ?$



$R_{AB} = R_{th} = ?$

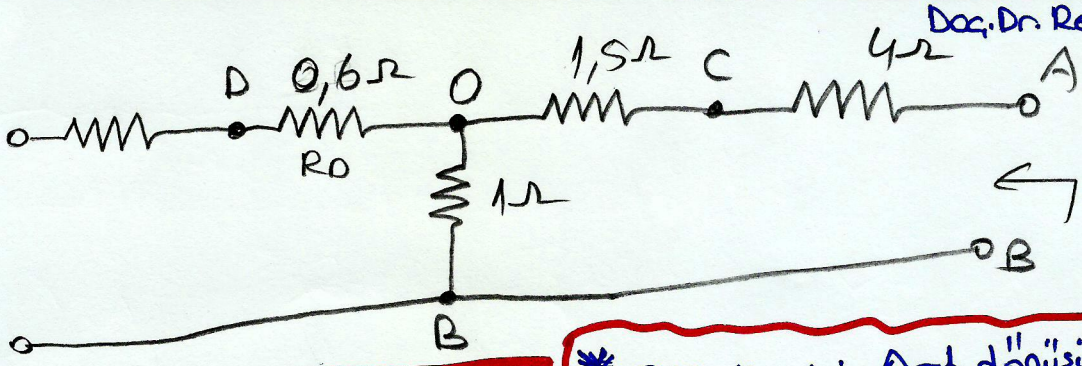
$\Delta \rightarrow \lambda$ dönüşümü

$\sum R_\Delta = 2+3+5 = 10\Omega$

$R_D = \frac{2.3}{\sum R_\Delta} = \frac{6}{10} = 0,6\Omega$

$R_C = \frac{3.5}{10} = 1,5\Omega$

$R_B = \frac{2.5}{10} = 1\Omega$



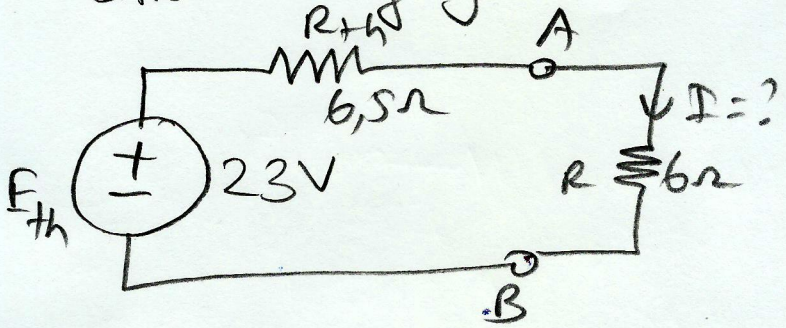
$R_{AB} = 1+1,5+4$

$R_{AB} = 6,5\,\Omega$

$R_{th} = R_{AB} = 6,5\,\Omega$

* Rth direnci Δ-λ dönüşümü yapmadanda hesaplayabilirsiniz. Arkadaki sayfa 3'ya bakınız.

Thevenin eşdeğer devresinde A-B arasına 6Ω'luk direnci bağlayalım:

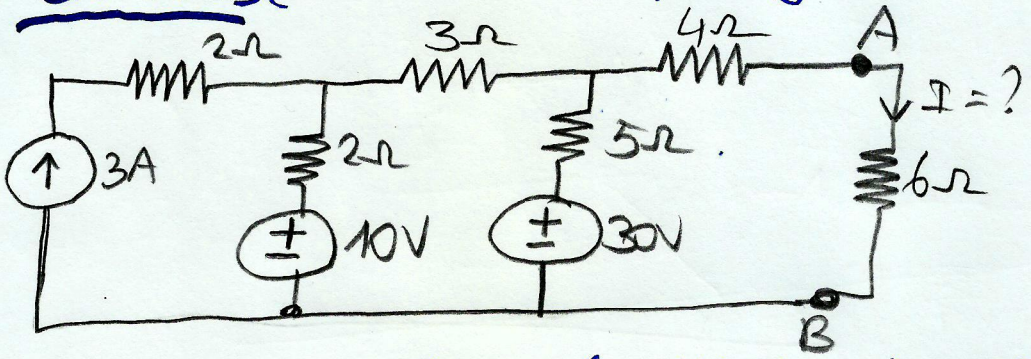


$$I = \frac{E_{th}}{R_{th}+R}$$

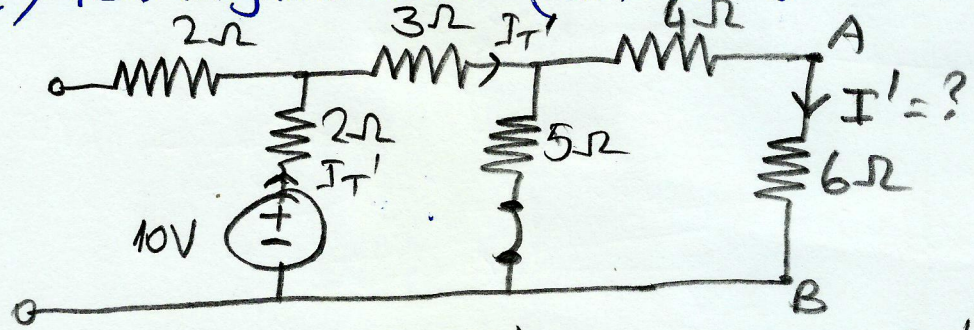
$$I = \frac{23}{6,5+6}$$

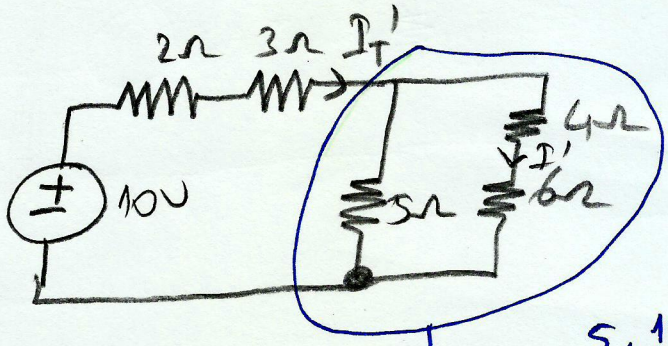
$$I = 1,84\,A$$

Örnek3 (DC Devre Süperpozisyon Teoremi)



i) 10V kaynak devrede (3A'lik kaynak açık devre, 30V'luk kaynak kısa devre)





$\equiv$

$R_{eq} = \frac{5.10}{5+10}$

$R_T' = 2+3+\left(\frac{5.10}{5+10}\right)$

$R_T' = 8,333\,\Omega$

$I_T' = \frac{10}{R_T'} = \frac{10}{8,333} = 1,2\,A$

Akım bölücüden

$I' = \frac{5}{5+10} \cdot I_T' = \frac{5}{15} \cdot 1,2$

$I' = 0,4\,A$ A→B

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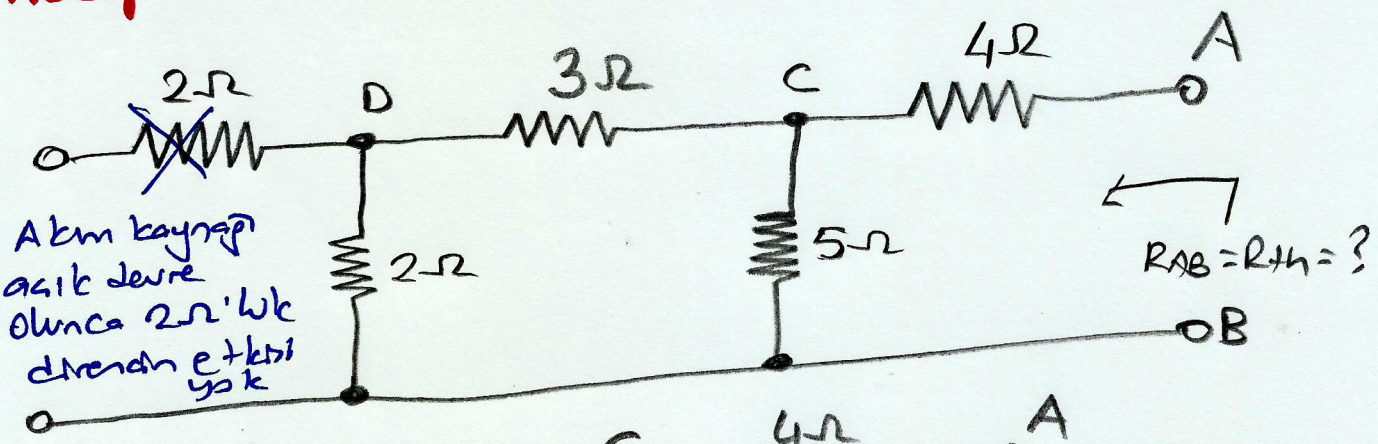
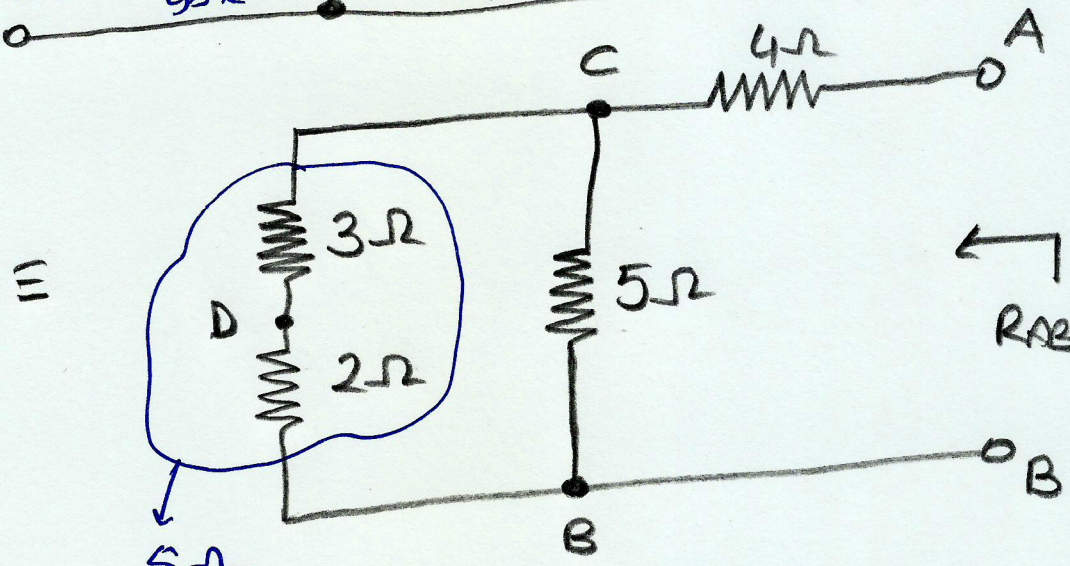
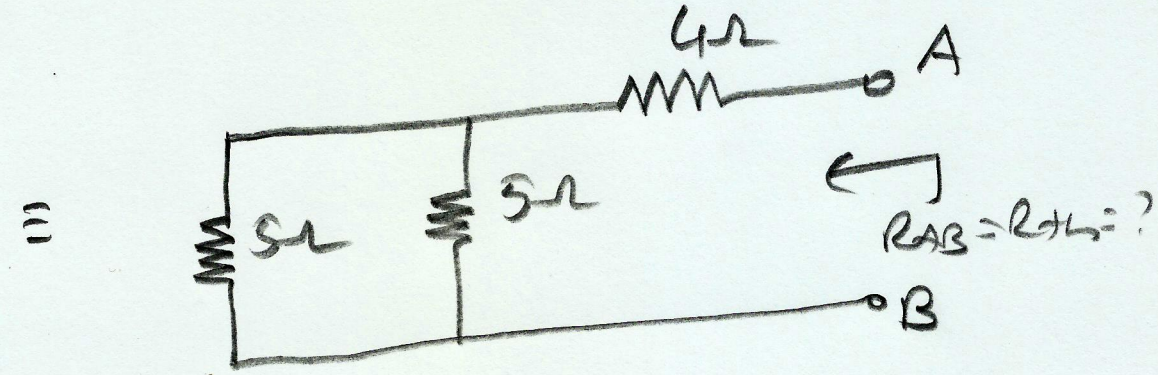
Örnek-2'deki Thevenin Teoremi sorusunda R_{th}'in $\Delta \rightarrow \lambda$ dönüşümü yapmadan daha kolay hesaplanması:







$$R_{th}=R_{AB}=\left(\frac{5.5}{5+5}\right)+4=2,5+4$$

$$\boxed{R_{th}=6,5\,\Omega}$$

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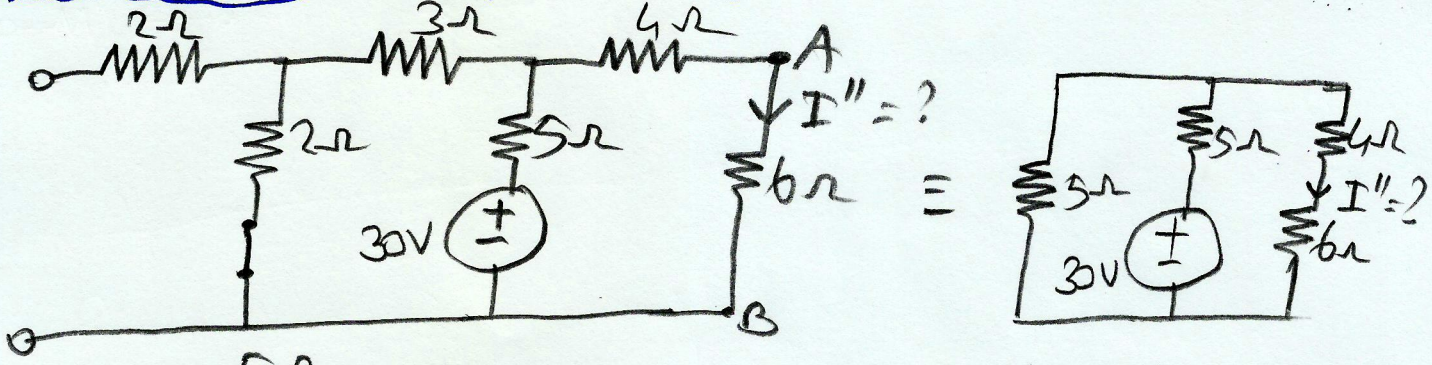
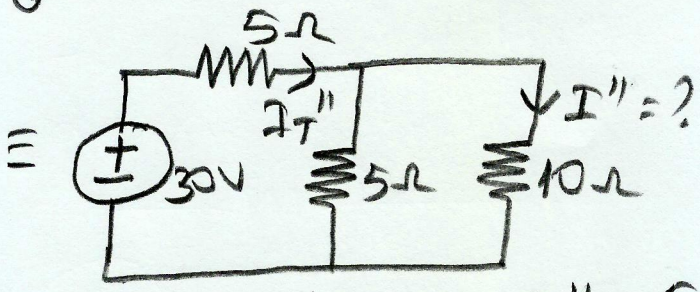
ii) 30V kaynak devrede (3A'lik kaynak açık devre, 10V'luk k.dev)





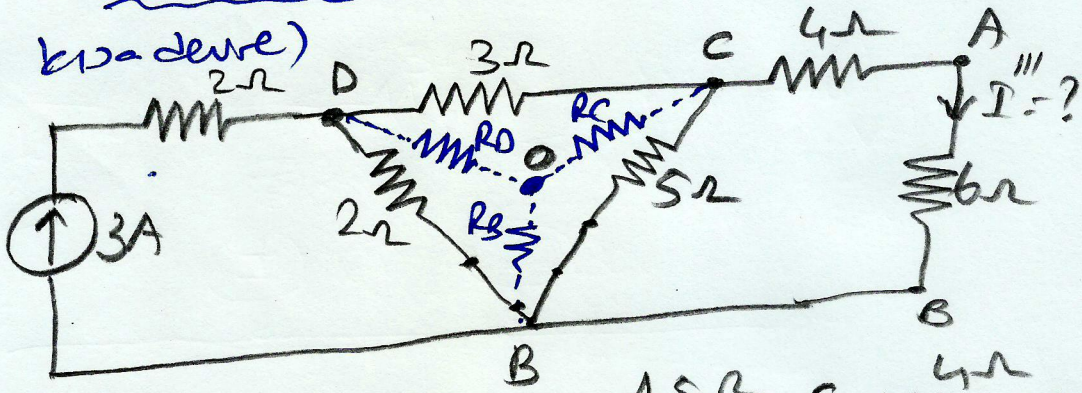
$$R_T'' = 5 + \left(\frac{5.10}{5+10}\right) = 8{,}333\,\Omega$$

$$I_T'' = \frac{30}{R_T''} = \frac{30}{8{,}333} = 3{,}6\,A$$

Akım bölücüden $I'' = \frac{5}{5+10} \cdot I_T'' = \frac{5}{15} \cdot 3{,}6$

$$\boxed{I'' = 1{,}2\,A \quad A \to B}$$

iii) 3A'lik kaynak devrede (10V'luk ve 30V'luk kaynak kısa devre)

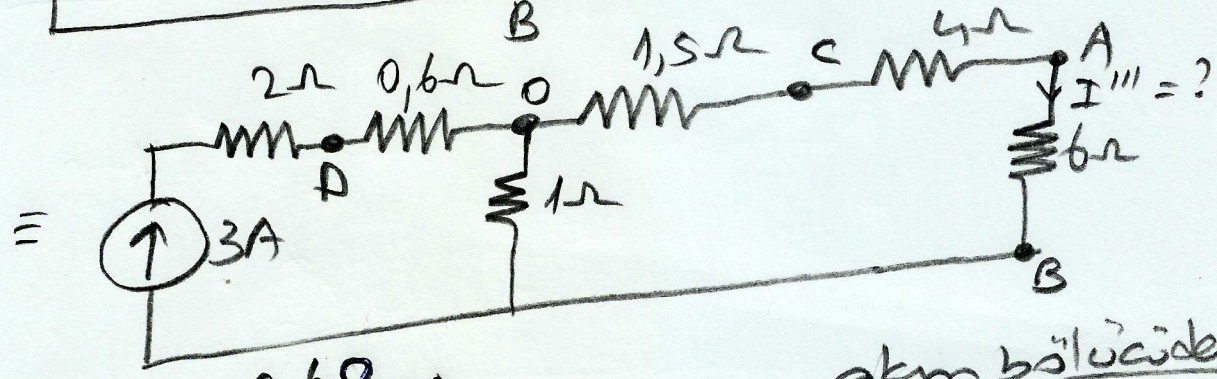


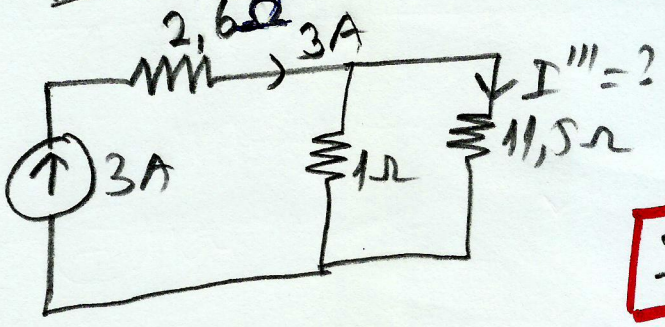
Δ → λ dönüşümü

$R_D = 0{,}6\,\Omega$

$R_C = 1{,}5\,\Omega$

$R_B = 1\,\Omega$



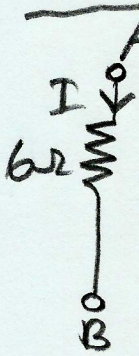


akım bölücüden

$$I''' = \frac{1}{1+11{,}5} \cdot 3$$

$$\boxed{I''' = 0{,}24\,A \quad A \to B}$$

Sonuçlar



I''' = 0,2A (3A'lik kaynaktan)

I'' = 1,2A (10V'luk kaynaktan)

I' = 0,4A (10V'luk kaynaktan)

$I = I' + I'' + I''' = 0,4 + 1,2 + 0,2 \Rightarrow$ **$I = 1,8A$**