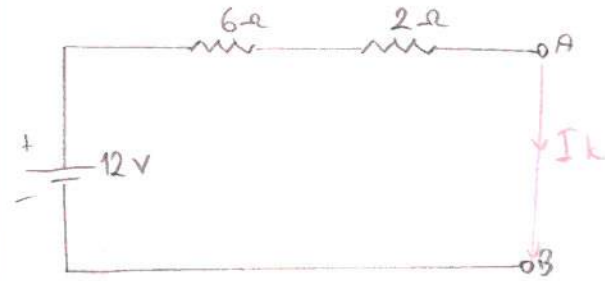


## NORTON TEOREMİ

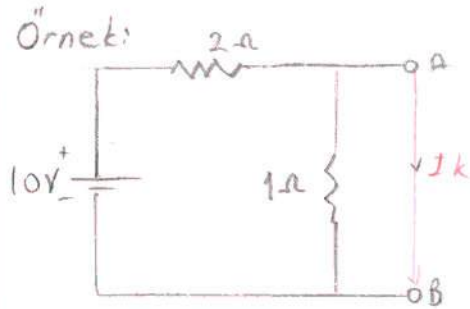
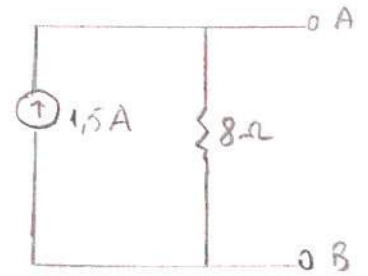
Bir elektrik devresi herhangi iki noktasına göre, bir akım kaynağı ve buna paralel bağlı bir dirençle gösterilebilir. İfade edilen devreye norton eşdeğeri denir. Devrenin belirlenen iki noktasının "kısa devre" edilmesi halinde buradan geçecek akım değeri; Norton eşdeğerindeki akım kaynağının değeridir. Eşdeğer devredeki akım kaynağına bağlı direncin değeri, devrenin belirlenen iki noktasına göre eşdeğer direncin değeridir. Eşdeğer direnci bulunurken devredeki gerilim kaynakları kısa devre, akım kaynakları ise açık devre kabul edilir.

Örnek: Şekildeki devrenin A-B uçlarına göre norton eşdeğerini bulunuz.



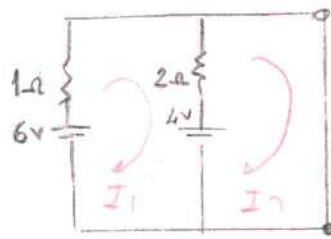
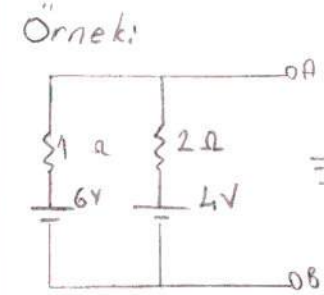
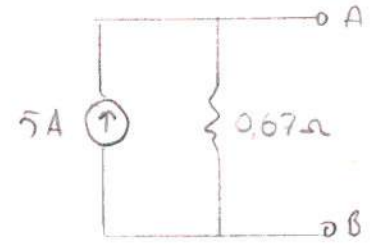
$$I_k = \frac{12}{6+2} = 1,5A$$

$$R_{A-B} = 6+2 = 8\Omega$$



$$I_k = \frac{10}{2} = 5A$$

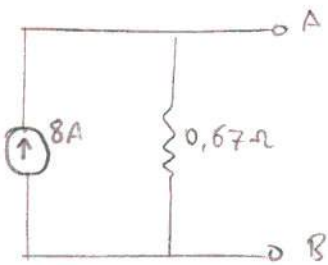
$$R_{A-B} = 2 \parallel 1 = 0,67\Omega$$



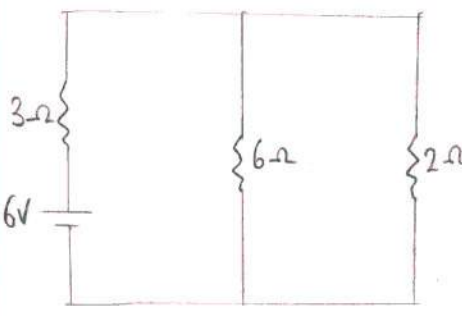
$$\begin{cases} 6-4 = 3I_1 - 2I_2 \\ 4 = 2I_2 - 2I_1 \end{cases} \Rightarrow \begin{cases} 3I_1 - 2I_2 = 2 \\ -2I_1 + 2I_2 = 4 \end{cases}$$

$$I_1 = 6A, I_2 = 8A$$

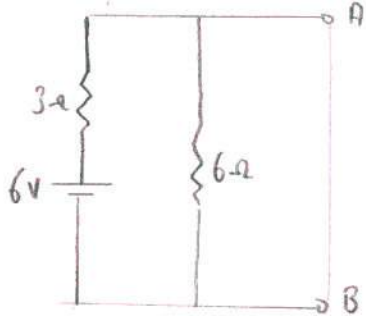
$$R_T = 1/2 = 0,67\Omega$$



Örnek: Şekildeki devrede  $2\Omega$ 'luk dirençten geçen akımı, norton teoremiyle bulunuz.

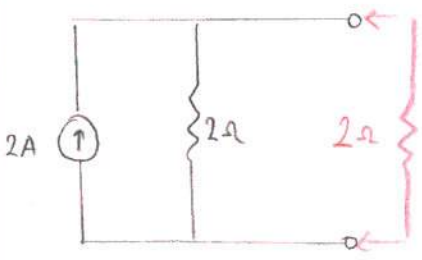


$2\Omega$  luk direnç devreden kırtılır ve bu uşkr kısa devre edilir.



$$I_{A-B} = \frac{6}{3} = 2A$$

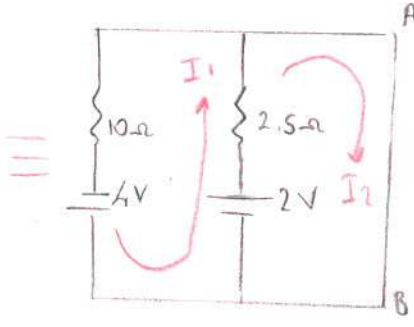
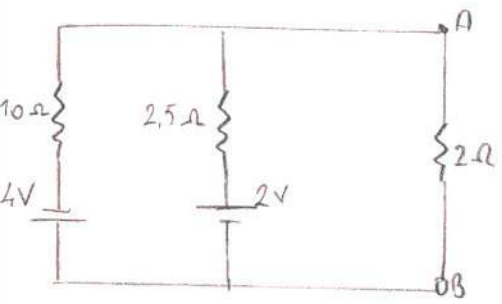
A-B arası esdeğer direnç  $\Rightarrow 3//6 = 2\Omega$  dir.



$2\Omega$ 'luk dirençten geçen akım;

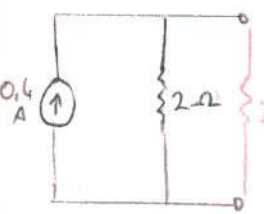
$$I_{2\Omega} = 2 \cdot \frac{2}{2+2} = 1A$$

Örnek:  $2\Omega$ 'luk dirençten geçen akımı norton teoremiyle bulunuz.



$$\begin{aligned} 12,5I_1 + 2,5I_2 &= 6 \\ 2,5I_2 + 2,5I_1 &= 2 \end{aligned}$$

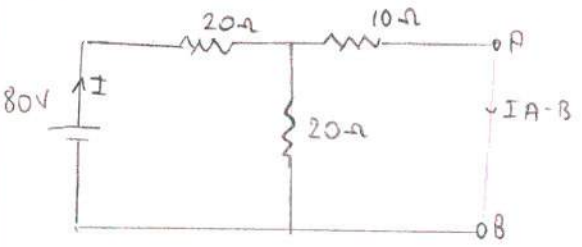
$$\begin{aligned} I_1 &= 0,4A \\ I_2 &= 0,4A \text{ bulunur.} \end{aligned}$$



$$R_{es} = 10//2,5 = 2\Omega$$

$2\Omega$ 'luk direnç üzerinden geçen akım  $\Rightarrow I_{2\Omega} = 0,2A$  dir

Örnek: Şekildeki devrenin norton esdeğerini bulunuz.

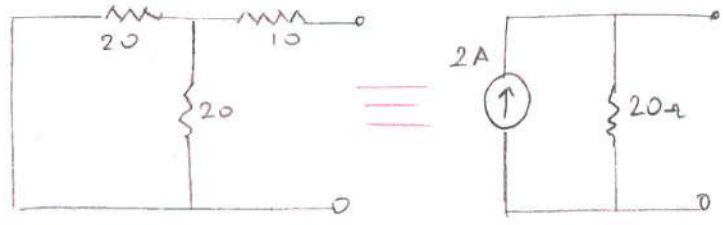


Kaynak tarafında bakıldığında esdeğer direnç;  
 $R_{es} = 20 + 10//20 = 20 + \frac{20 \cdot 10}{20+10} = 20 + \frac{20 \cdot 10}{30} = 26,67\Omega$

Devreden geçen toplam akım I;

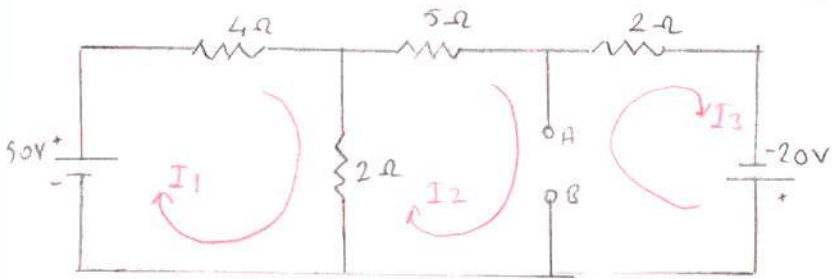
$$I = \frac{U}{R_{es}} = \frac{80}{26,67} = 3A \text{ dir, } I_{AB} = \frac{3 \cdot 20}{10+20} = 2A \text{ dir.}$$

A-B arası esdeğer direnç;



$$R_{A-B} = 20//20 + 10 = 20\Omega \text{ dir.}$$

Örnek: Şekildeki devrenin norton emdgerini bulunuz.



$$6I_1 - 2I_2 + 0I_3 = 50$$

$$-2I_1 + 7I_2 - 0I_3 = 0$$

$$0I_1 - 0I_2 + 2I_3 = 20$$

$$6I_1 - 2I_2 = 50 / 2 \Rightarrow 3I_1 - I_2 = 25 \times 7 \Rightarrow 21I_1 - 7I_2 = 175$$

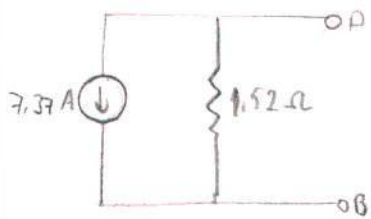
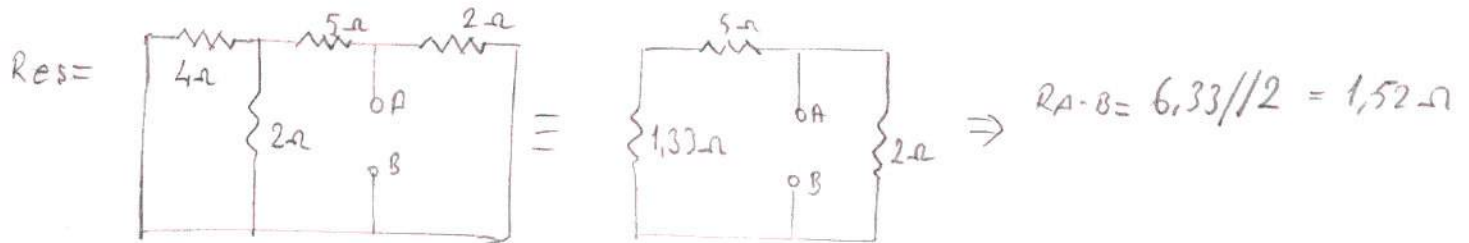
$$+ \frac{-2I_1 + 7I_2 = 0}{19I_1 = 175 \Rightarrow I_1 = 9,21A}$$

$$19I_1 = 175 \Rightarrow I_1 = 9,21A$$

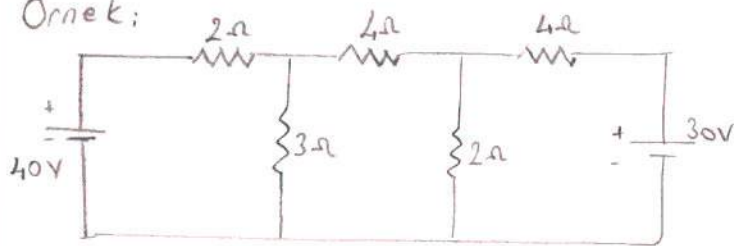
$$3I_1 - I_2 = 25 \Rightarrow 27,63 - I_2 = 25 \Rightarrow I_2 = 2,63A$$

$$2I_3 = 20 \Rightarrow I_3 = 10A$$

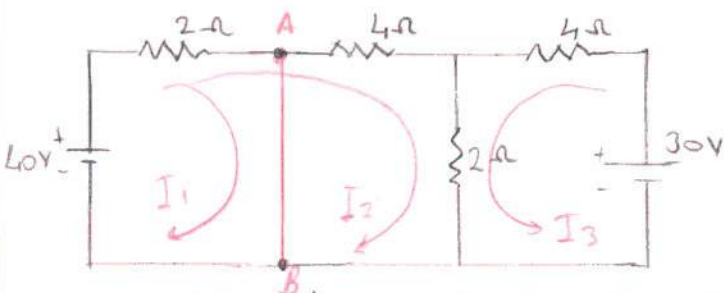
$$I_{A-B} = I_3 - I_2 = 10 - 2,63 = 7,37A$$



Örnek:



3a'lık dirençten geçen akımı norton teoremininle yararlanarak bulunuz.



3a'lık direnç devreden çıkartılır ve bu yollar kısa devre edilerek buradan geçen akım (I1) bulunur.

$$2I_1 + 2I_2 = 40$$

$$2I_1 + 8I_2 + 2I_3 = 40$$

$$0I_1 + 2I_2 + 6I_3 = 30$$

$$I_1 + I_2 + 0 = 20$$

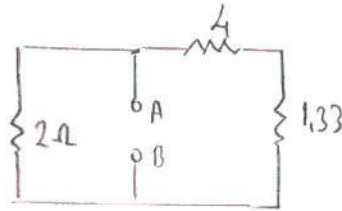
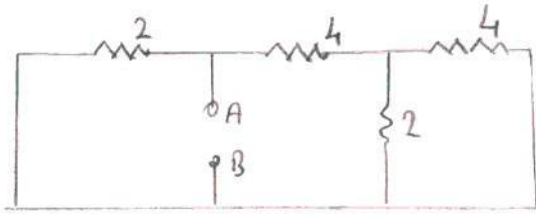
$$I_1 + 4I_2 + I_3 = 20$$

$$0I_1 + I_2 + 3I_3 = 15$$

$$\Delta = \begin{vmatrix} 1 & 1 & 0 & 1 & 1 \\ 1 & 4 & 1 & 1 & 4 \\ 0 & 1 & 3 & 0 & 1 \end{vmatrix} = 12 - (43) = 8$$

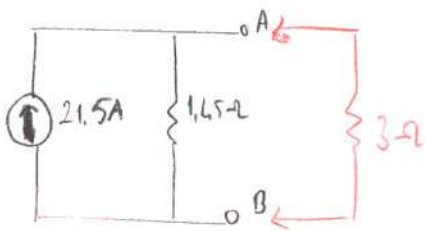
$$\Delta_1 = \begin{vmatrix} 20 & 1 & 0 & 20 & 1 \\ 20 & 4 & 1 & 20 & 4 \\ 15 & 1 & 3 & 15 & 1 \end{vmatrix} = 240 + 15 - (20 + 60) = 175$$

$$I_1 = \frac{\Delta_1}{\Delta} = \frac{175}{8} = 21,5 \text{ A}$$



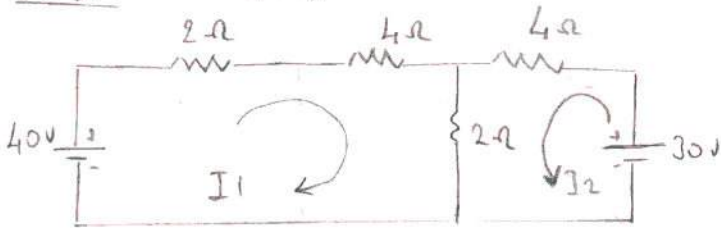
$$R_{A-B} = 2 // 5,33$$

$$R_{A-B} = 1,45 \Omega$$



$$I_{3-A} = 21,5 \cdot \frac{1,45}{1,45+3} = 7 \text{ Amper}$$

II. Yol Thevenin;



$$6I_1 - 2I_2 = 40$$

$$2I_1 + 6I_2 = 30$$

$$18I_1 - 6I_2 = 60$$

3 ile carp

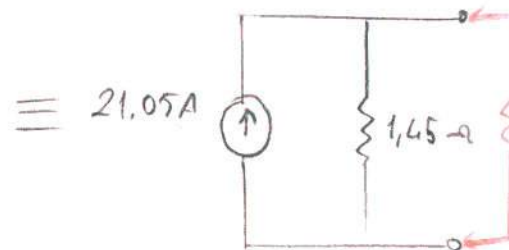
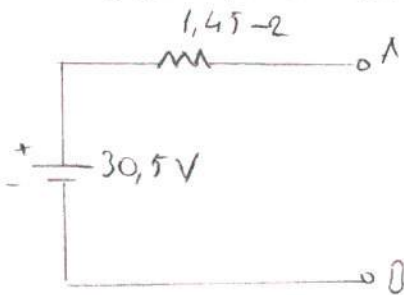
$$18I_1 = 90 \Rightarrow I_1 = 4,73 \text{ A}$$

$$I_2 = 3,42 \text{ A}$$

A-B noktalarına göre eşdeğer direnç;  
 $R_{A-B} = 2 // 5,33$   
 $R_{A-B} = 1,45 \Omega$

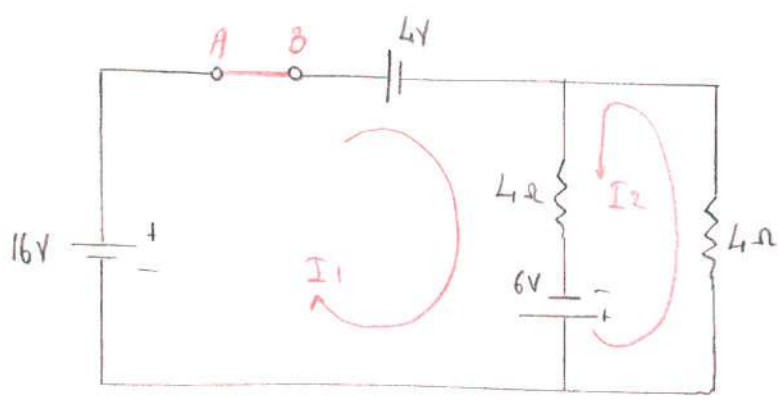
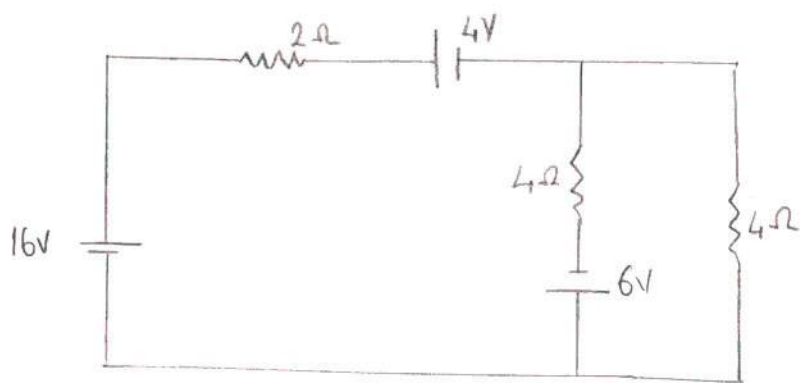
$$U_{A-B} = 40 - 2 \cdot I_1 = 30,54 \text{ V}$$

Devrenin A-B noktalarına göre Thevenin eşdeğeri:



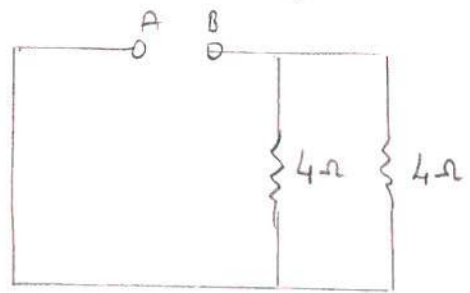
$$I_{3-A} = 21,05 \cdot \frac{1,45}{1,45+3} = 7 \text{ A}$$

Örnek: Şekildeki devrede  $2\Omega$ 'luk dirensten geçen akımı norton teoremi-nden yararlanarak bulunuz.

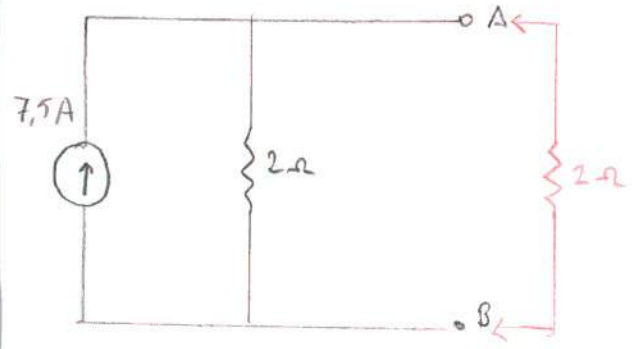


$$\begin{aligned}
 4I_1 + 4I_2 &= 18/4 \\
 4I_1 + 8I_2 &= 6/-4 \\
 \hline
 I_1 + I_2 &= 4,5 \\
 -I_1 - 2I_2 &= -1,5 \\
 \hline
 -I_2 &= 3 \Rightarrow \underline{I_2 = -3A} \\
 4,5 &= I_1 - 3 \\
 \underline{I_1} &= \underline{7,5A}
 \end{aligned}$$

A-B arası eşdeğer direnç



$$R_{A-B} = 4//4 = 2\Omega \text{ dir.}$$



$2\Omega$ 'luk dirensten geçen akımı

$$R_{2\Omega} = \frac{8,5}{2} = 3,75A$$