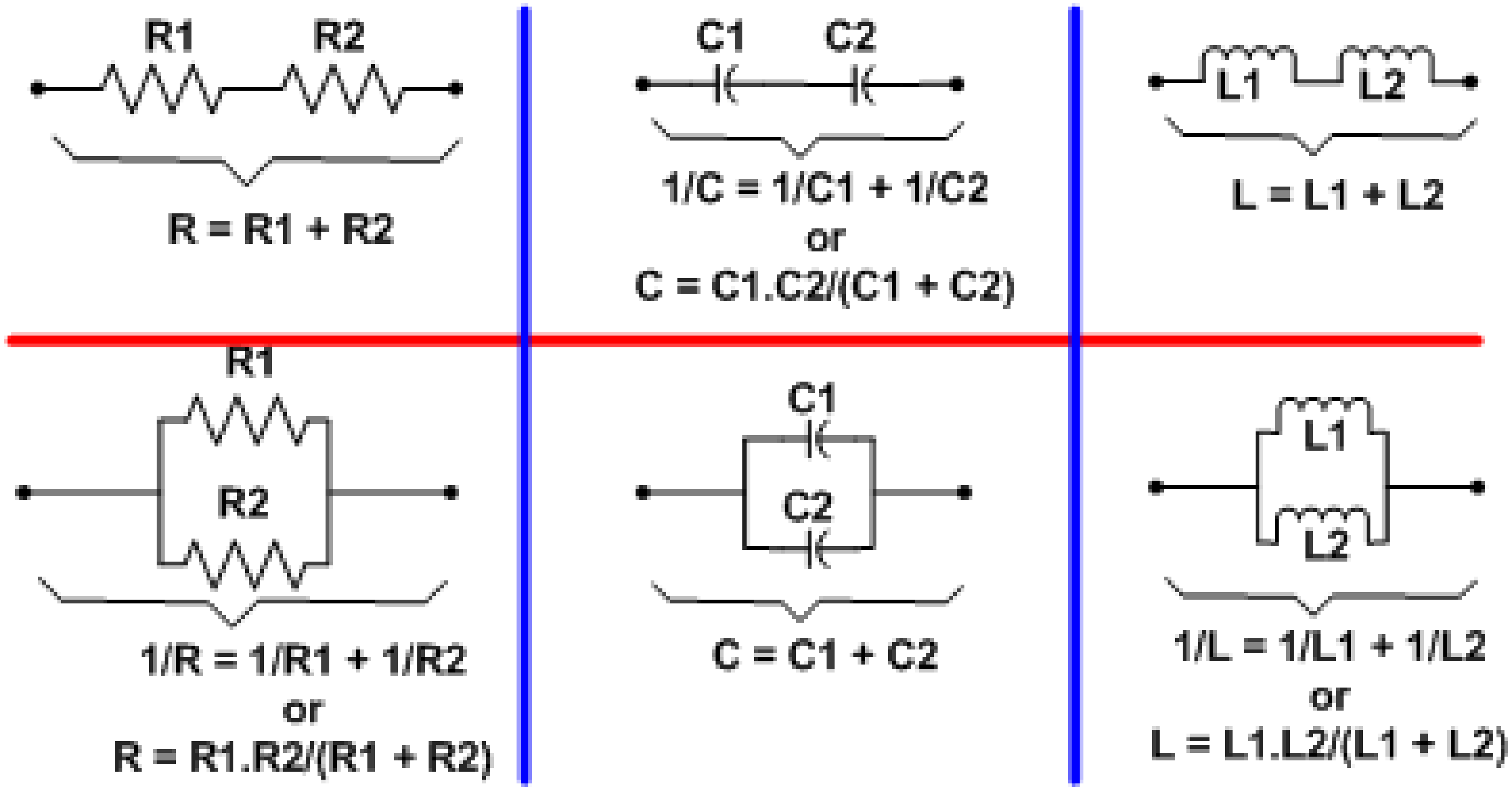
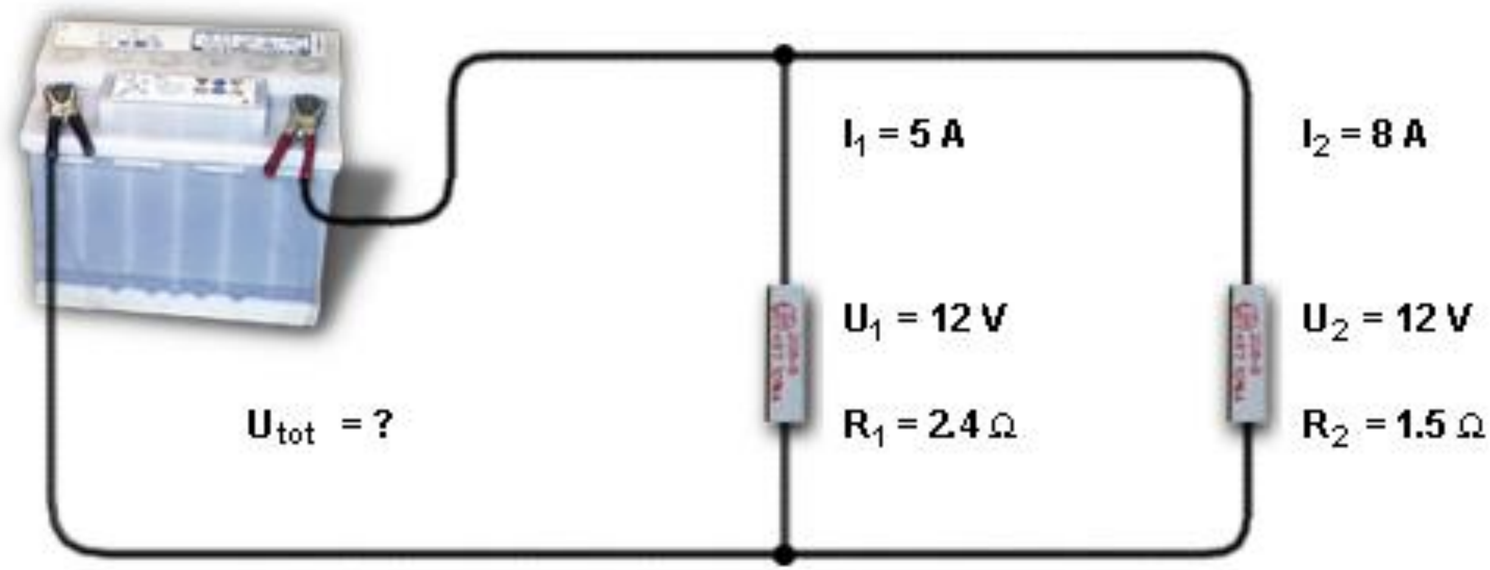
SERİ VE PARELEL BAĞLAMA

Series and Parallel Combinations

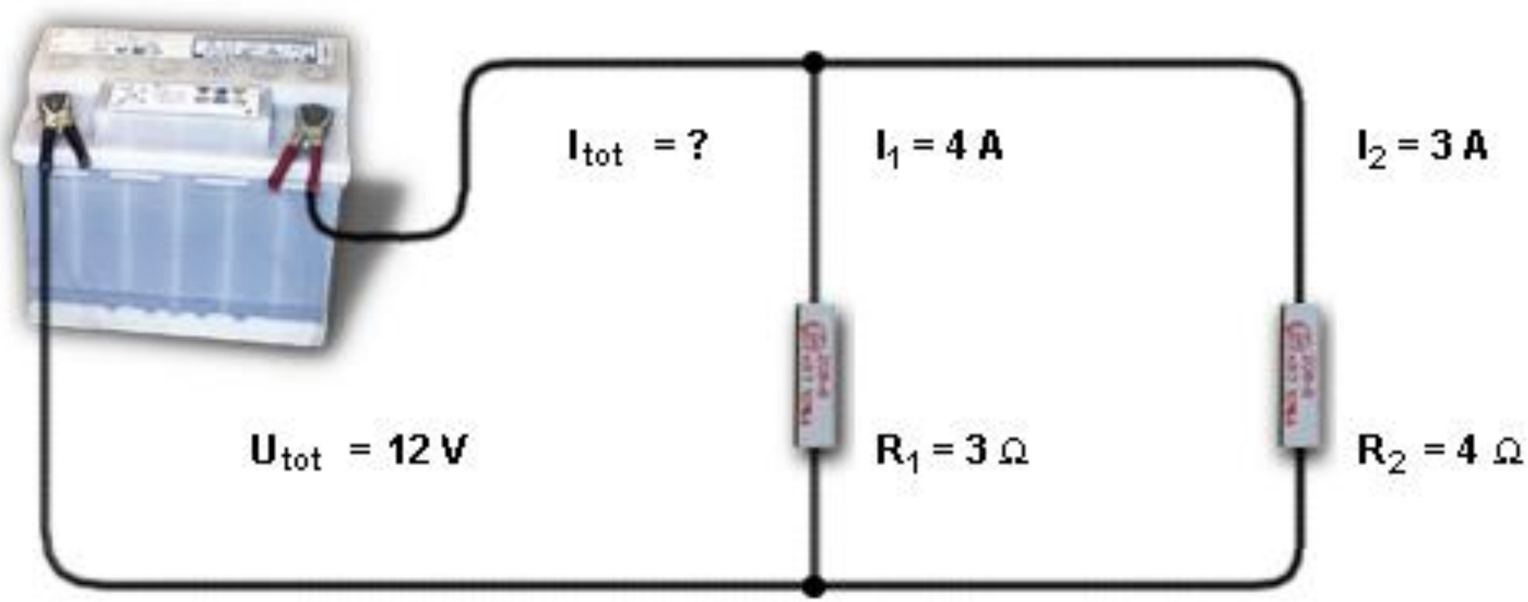


DEVRE ÖRNEKLEME



$$U_{tot} = U_1 = U_2 = 12\ V$$

DEVRE ÖRNEKLEME



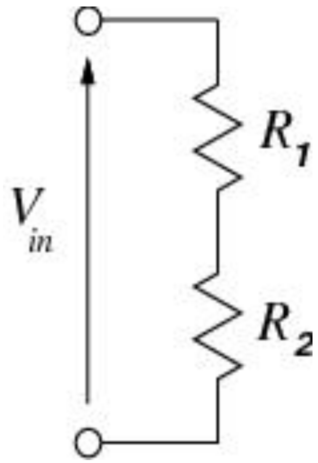
$U_{tot} = U_1 = U_2 = 12\ V$

$I_{tot} = I_1 + I_2$

$I_{tot} = 4\ A + 3\ A = 7A$

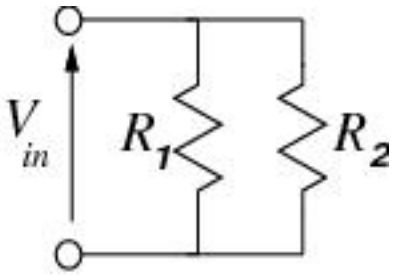
Resistors

series combination



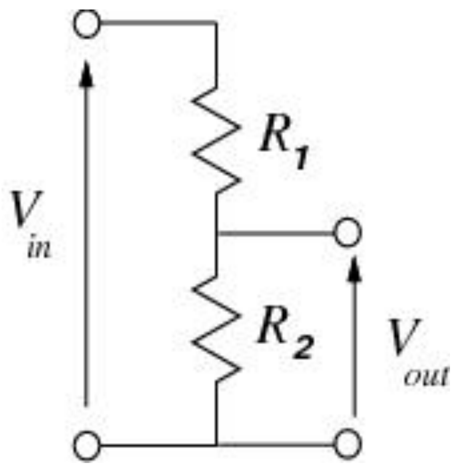
$$R_{eq} = R_1 + R_2$$

parallel combination



$$R_{eq} = \frac{1}{\frac{1}{R_1} + \frac{1}{R_2}}$$

Voltage Divider

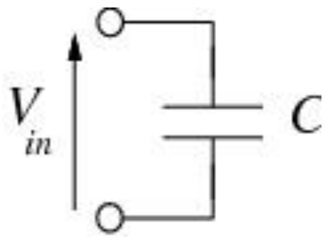


$$V_{out} = \frac{R_2}{R_1 + R_2} V_{in}$$

Capacitors

$$Q = C\ V$$

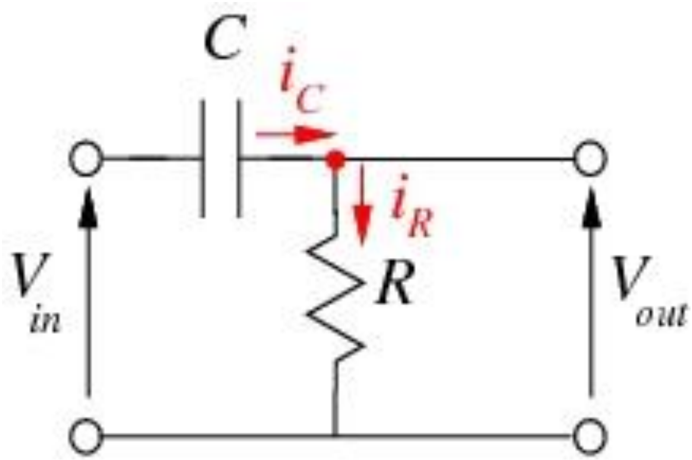
- capacitance - [Farads]: Michael Faraday
- capacitor - two terminal device that stores energy in the form of an electric charge



differentiating, we get $I = \frac{dQ}{dT} = C\frac{dV}{dt}$

- doğru gerilimin değeri zamanla değişmez.
- two conductors separated by a thin layer of dielectric
- capacitance ~ conductor surface area, thinness of dielectric
- two adjacent wires in a ribbon cable are subject to capacitive crosstalk (ground every other wire)
- big capacitors are *polarized*, terrible accuracy, temperature stability, leakage, and lifetime---a loud buzzing noise from electronics could be an electrolytic capacitor has died

RC Circuits



$$\sum i = 0 = i_c - i_r$$
$$= C\frac{d}{dt}(V_{in} - V_{out}) - \frac{V_{out}}{R}$$

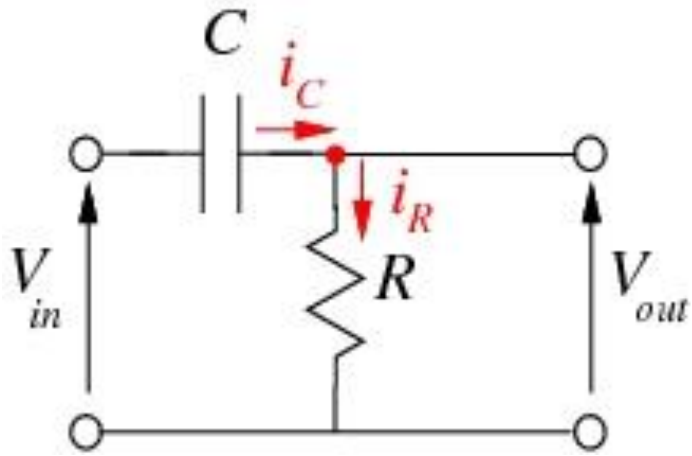
so that, if $V_{in} = const$

$$0 = (Cs + \frac{1}{R})V_{out}(s)$$

which has the solution

$$V_{out}(t) = V_0 exp(\frac{-t}{RC})$$

RC Circuits

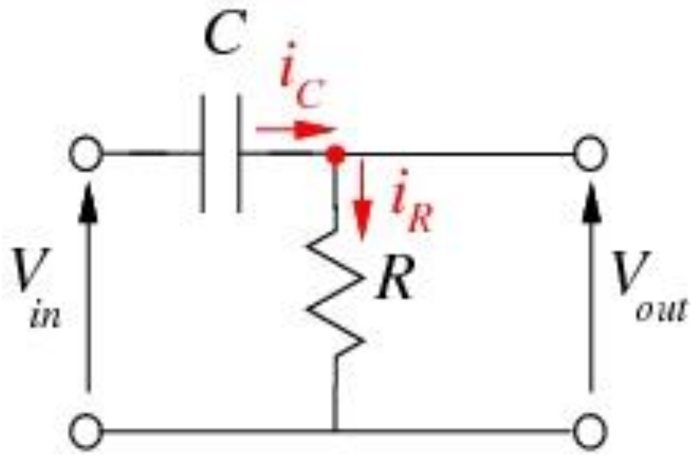


$$V_{out}(t) = V_0 exp(\frac{-t}{RC})$$

timing - RC is called the time constant, τ, of the circuit, voltage will fall to 37% of its initial value in RC seconds.

smoothing - high frequency noise on top of a slowly varying signal can be rejected by observing the signal through a relatively large RC time constant

RC Differentiator



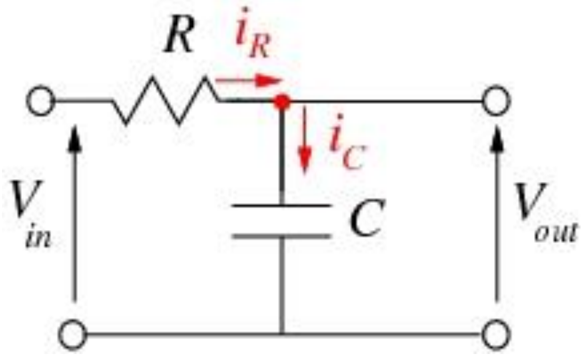
$$I = C\frac{d}{dt}(V_{in} - V_{out}) = \frac{V_{out}}{R}$$

choose R and C small so V_{out} is small

$$V_{out}(t) = RC\frac{d}{dt}V_{in}(t)$$

note - this can happen by accident, if a smooth signal is corrupted with noise, maybe it's capacitive coupling---perhaps a digital line is too close to an analog signal.

RC Integrator

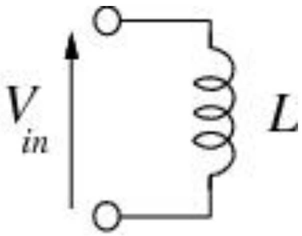


$$I = C\frac{dV_{out}}{dt} = \frac{V_{in} - V_{out}}{R}$$

choose R and C large so V_{out} is small $$C\frac{dV}{dt} \approx \frac{V_{in}}{R}$$

$$V(t) = \frac{1}{RC}\int V_{in}(t)dt + constant$$

Inductors



- inductance - [Henries]: 1 volt across 1 Henry produces a current that increases at 1 amp per second

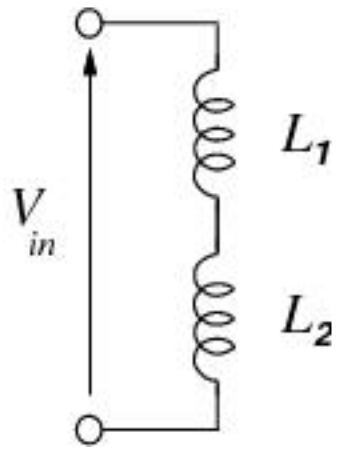
$$V = L\frac{dI}{dT}$$

- an inductor is normally formed from a coil of wire that may be wound on a core of magnetic material.
- a voltage source across an inductor causes the current to rise as a ramp.
- stopping a current going through an inductor generates a high voltage.

Inductors

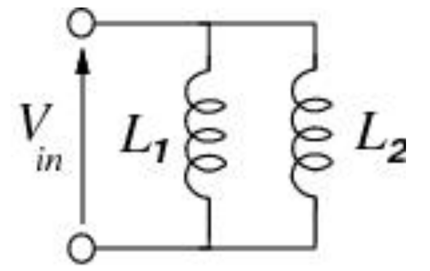
no mutual inductance

series combination



$$L_{eq} = L_1 + L_2$$

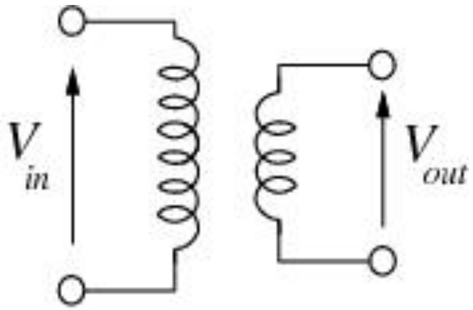
parallel combination



$$L_{eq} = \frac{1}{\frac{1}{L_1} + \frac{1}{L_2}}$$

Transformers

primary



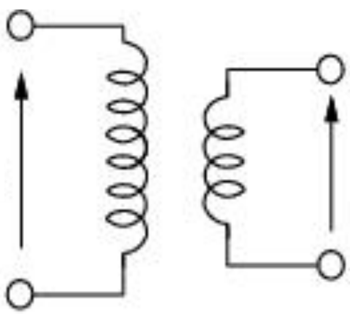
secondary

"*gearbox*"
for AC voltage and current

$V \sim \tau \qquad I \sim \omega$

constant power: VI ($\tau\omega$)

V_{in}

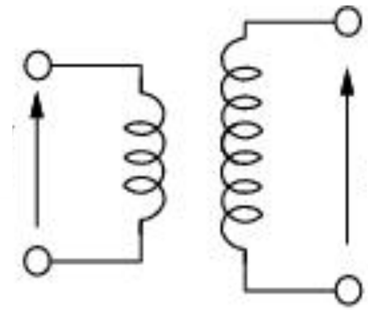


V_{out}

step-down:
less voltage
more current

6 : 3 η=6/3

V_{in}



V_{out}

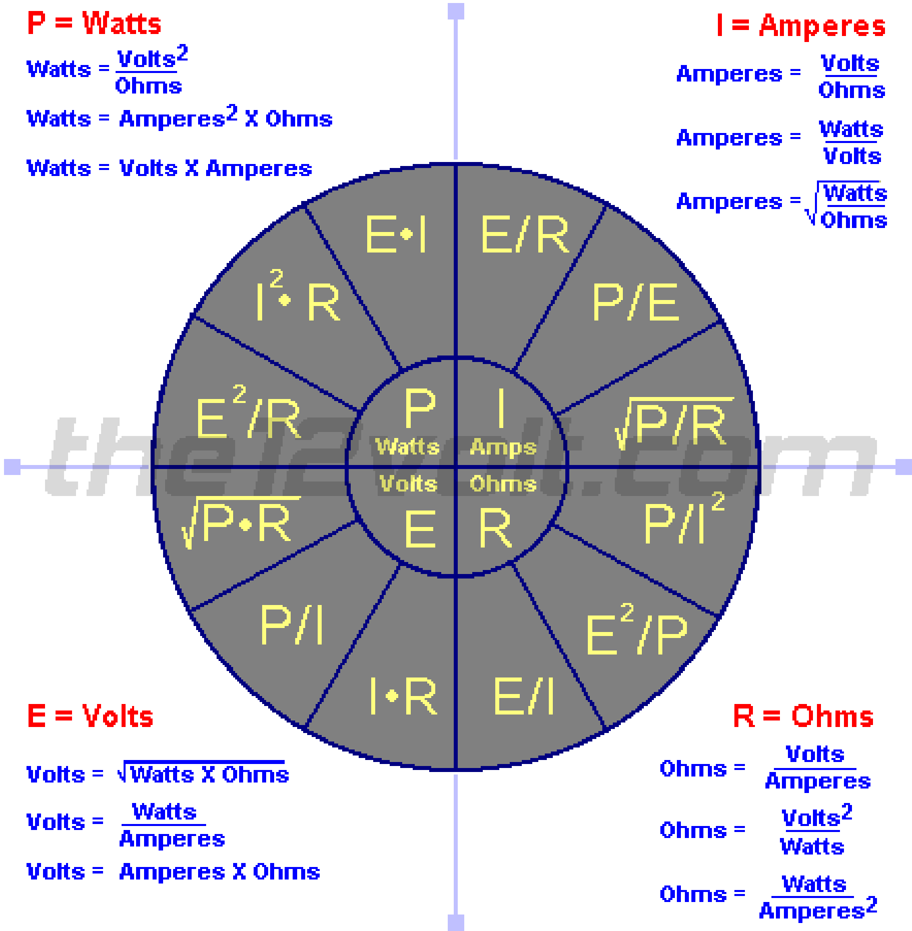
step-up:
more voltage
less current

3 : 6 η=3/6

- transformers are the main reason why AC power is used.
- often first stage for low voltage DC power

Mathematics for Electronics

Students will understand the mathematical processes and applications that lead to solutions of electronic problems.



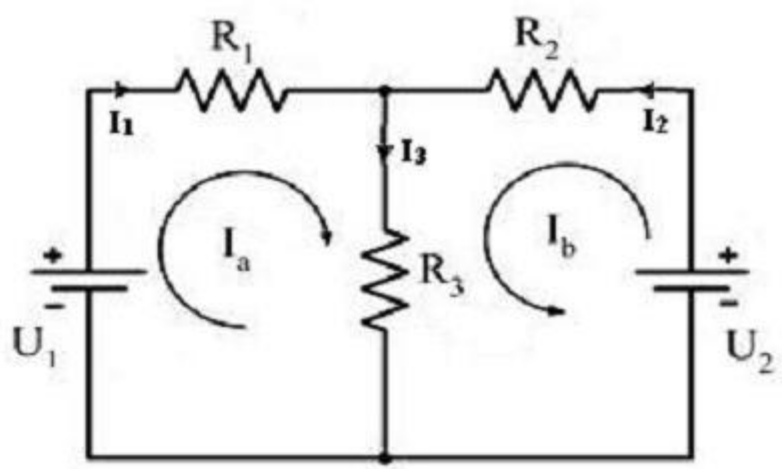
P = Power (watts or volt-amps)

I = Intensity (current in amps)

E = Electromotive Force (Voltage)

R = Resistance (Ohms)

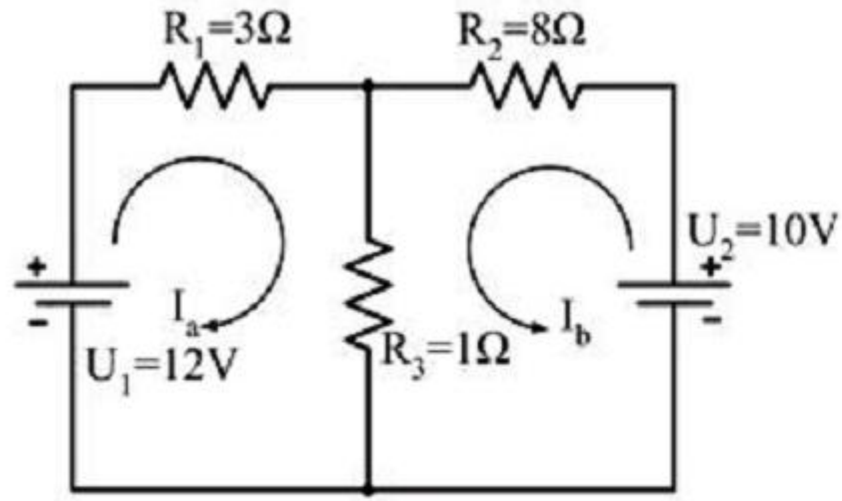
Çevre Akımları



$$U_1 = (R_1 + R_3).Ia + R_3.Ib$$

$$U_2 = R_3.Ia + (R_2 + R_3).Ib$$

- Bu yöntemde, devrenin her bir gözü için (Herhangi bir çevrenin seçilmesinde de sakınca yoktur) bir çevre akımı ve yönü seçilir
- Seçilen bu çevre akımlarından faydalanarak Kirşof'un Gerilimler Kanunu her bir göze uygulanır ve göz adedi kadar denklem yazılır. Göz adedi kadar bilinmeyen çevre akımı olduğundan, elde edilen göz adedi kadar denklem çözülerek her bir gözün çevre akımı bulunur. Sonrada çevre akımları kullanılarak kol akımları kolaylıkla bulunabilir.



Şekil 1.20

$$12 = 4.I_a + 1.I_b \qquad 12 = 4I_a + I_b$$

$$(-4).10 = 1.I_a + 9.I_b \qquad -40 = -4I_a - 36I_b$$

$$-28 = -35I_b$$

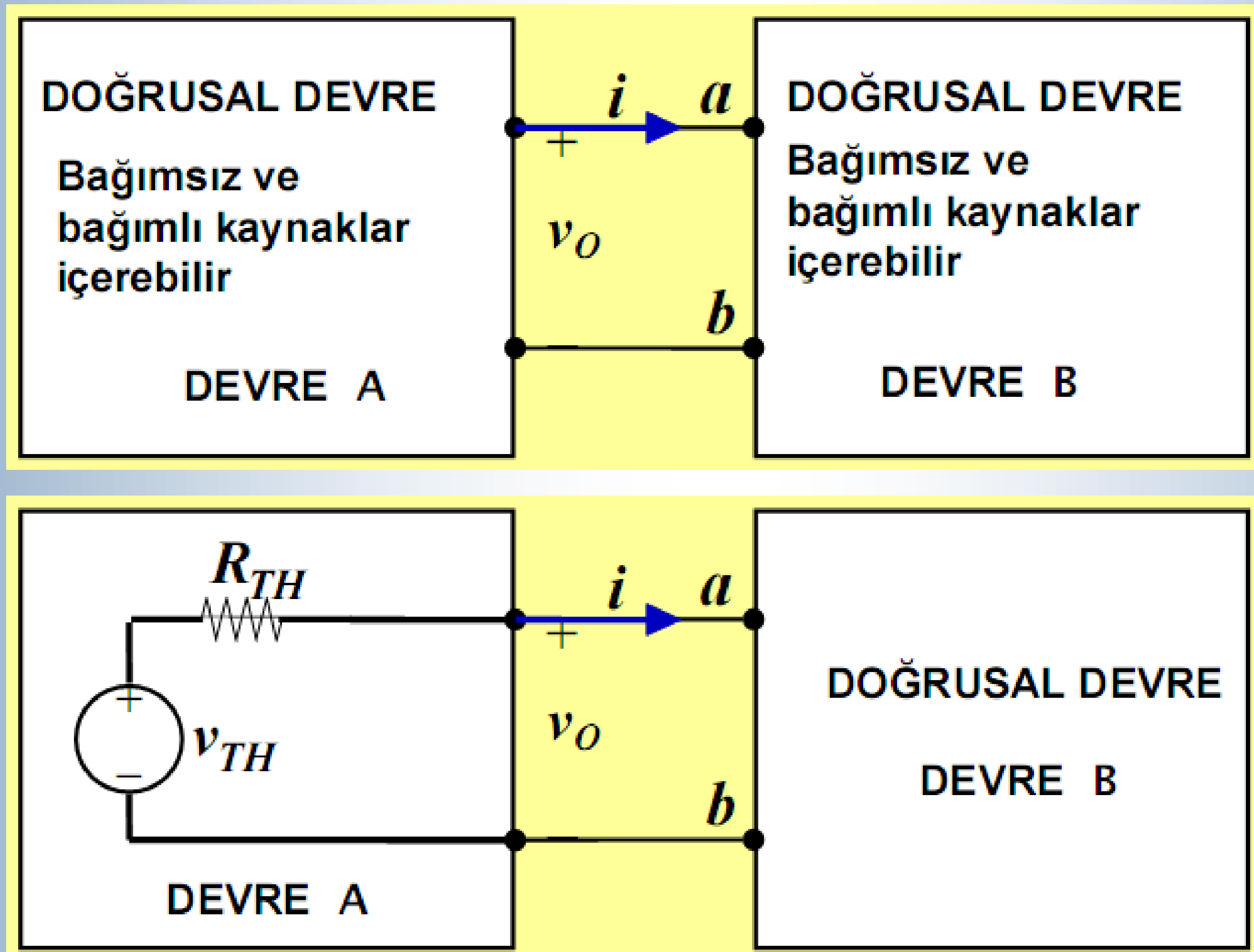
$I_b = 0,8$ A olarak bulunur.

$$12 = 4I_a + I_b \Rightarrow I_a = \frac{12 - 0,8}{4} = 2,8A \text{ olarak bulunur.}$$

$I_1 = I_a = 2,8A$
$I_2 = I_b = 0,8A$
$I_3 = I_a + I_b = 2,8 + 0,8 = 3,6A$ olarak bulunur.

Thevenin Teoremi

- Bu teoreme göre elektrik devreleri bir direnç ve ona seri bağlı olan bir üreteç eşdeğeri ile temsil edilebilir.
  - Gerilim kaynakları kısa devre, akım kaynakları ise açık devre yapılarak Thevenin eşdeğer direnci bulunur.
  - Thevenin en çok bağımlı kaynaklarının dönüşümünde işimize yarar. Bağımlı kaynağın etkisi devrede Thevenin eşdeğer direnci olarak kendini gösterir. Böylece devreyi bağımlı kaynaklardan arındırılmış bir şekilde çözebiliriz.*



Thevenin Eşdeğer Devresi

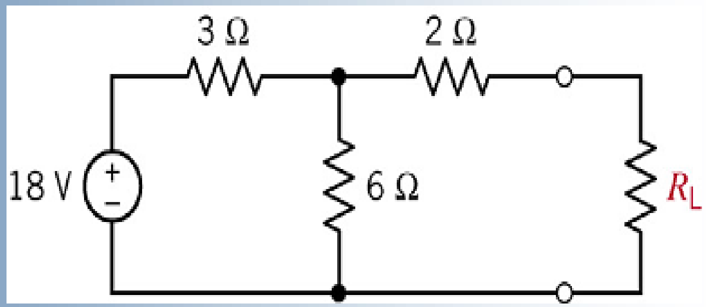
DEVRE A için

v_{TH} Thevenin Esdeger Kaynagi

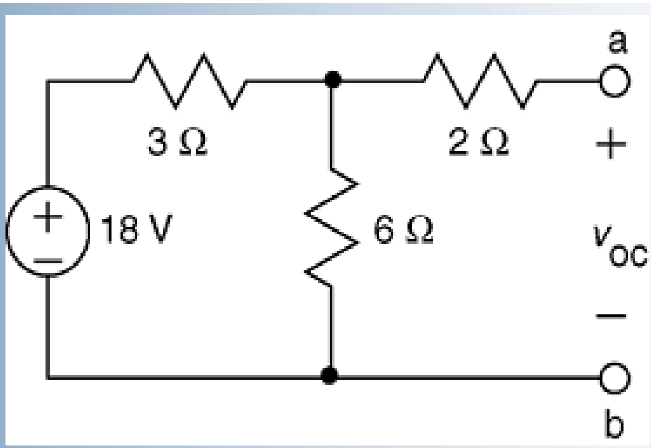
R_{TH} Thevenin Esdeger Direnci

Thevenin

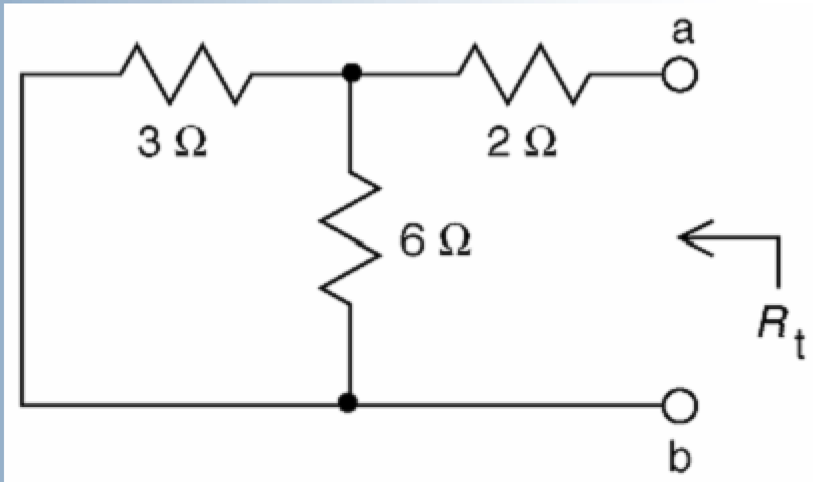
Örnek-1



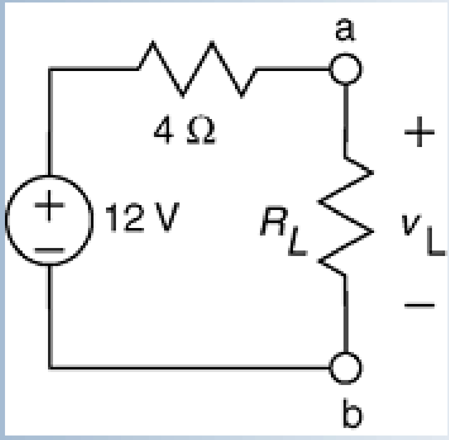
R_L üzerinde düşen gerilimi bulunuz,



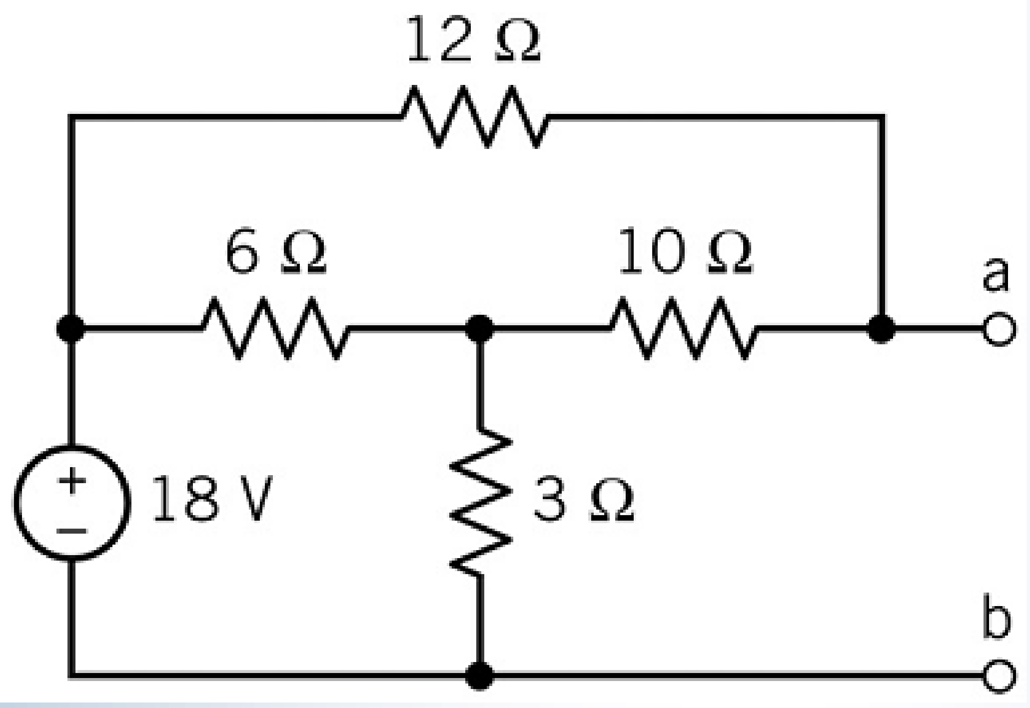
$$v_{oc} = \frac{6}{6+3}(18) = 12 \text{ V}$$

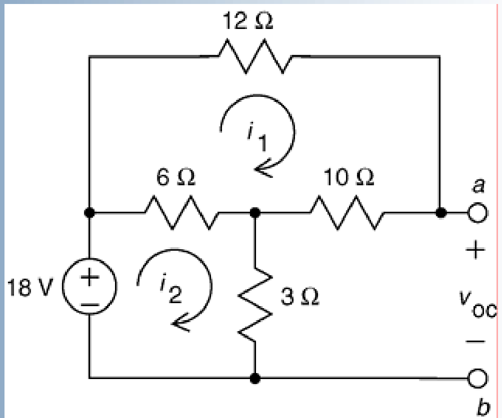


$$R_t = 2 + \frac{(3)(6)}{3+6} = 4\ \Omega$$



Thevenin 2





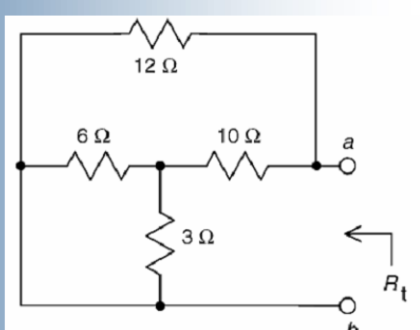
$$12\,i_1 + 10\,i_1 - 6\left(i_2 - i_1\right) = 0$$

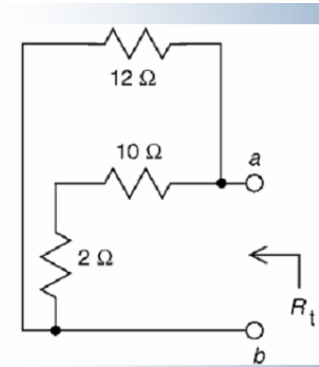
$$6\left(i_2 - i_1\right) + 3\,i_2 - 18 = 0$$

$$i_1 = \frac{1}{2}\ \mathrm{A}$$

$$i_2 = \frac{7}{3}\ \mathrm{A}$$

$$v_{oc} = 3\,i_2 + 10\,i_1 = 3\left(\frac{7}{3}\right) + 10\left(\frac{1}{2}\right) = 12\ \mathrm{V}$$

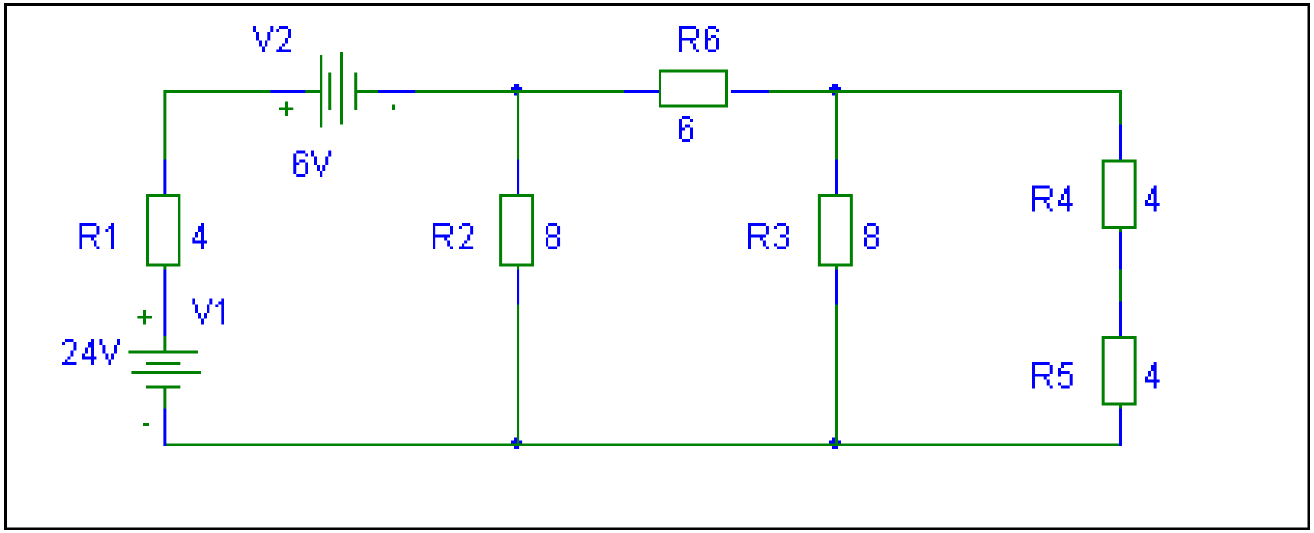




$$R_t = \frac{12(10+2)}{12+(10+2)} = 6\ \Omega$$

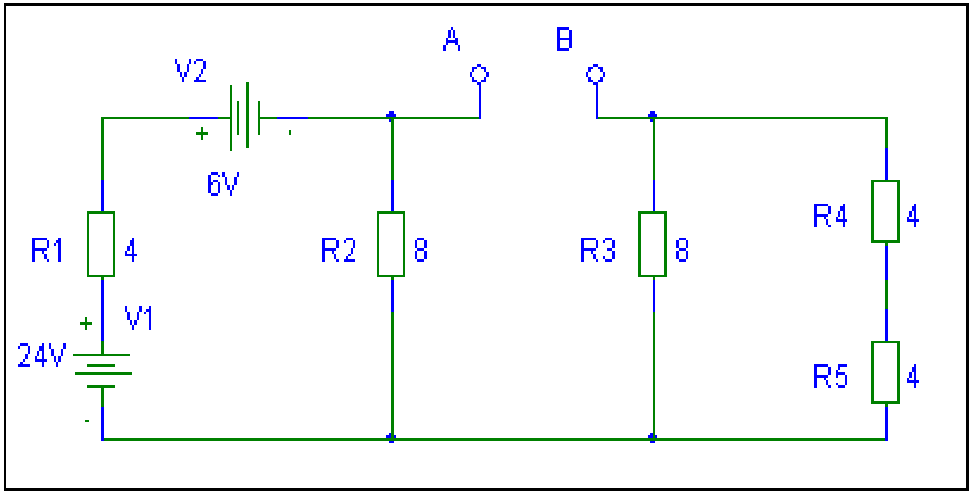
Thevenin Örnek

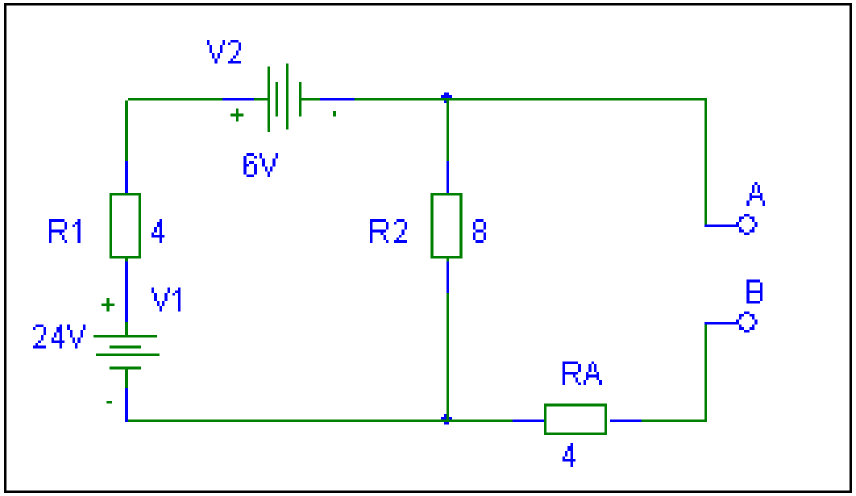
- R6 daki Thevenin Eşdeğer devresini bulunuz



1. Adım

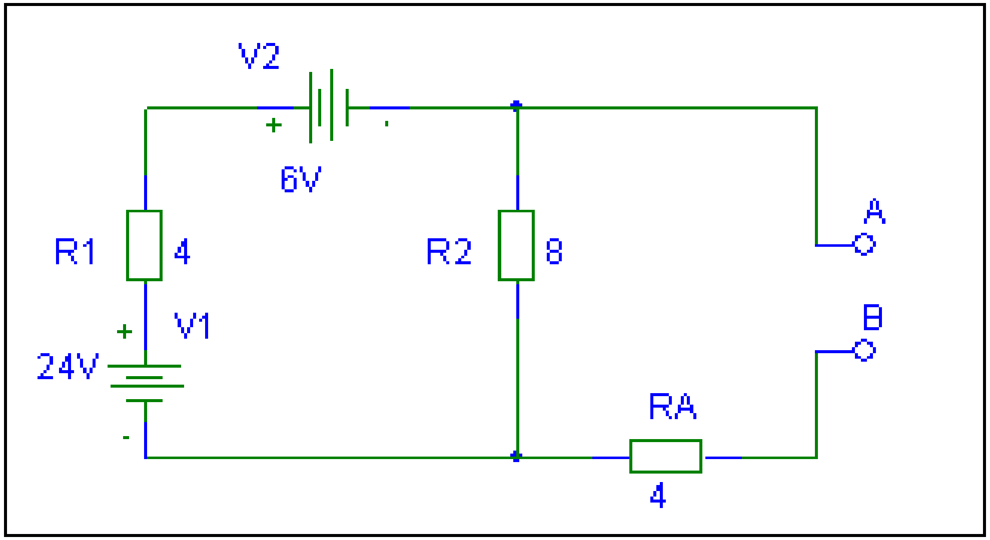
- R3//(R4+R5) =RA=4Ω





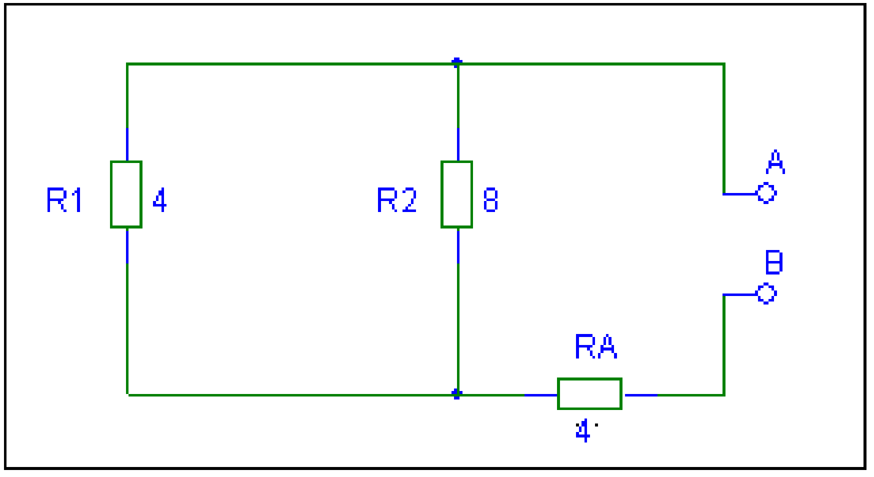
2. Adım Vth

- **I = V/R = (24-6) /12 = 1.5Amps**
  - **RA üzerinden Akım akmaz**
  - **V1 ve V2 birbirine ters olduğu için çıkarılır.**
  - **R1 ve R2 birbirlerine Seridir.**
- **VT = I R2 = (1.5 x 8W) = 12 Volts**



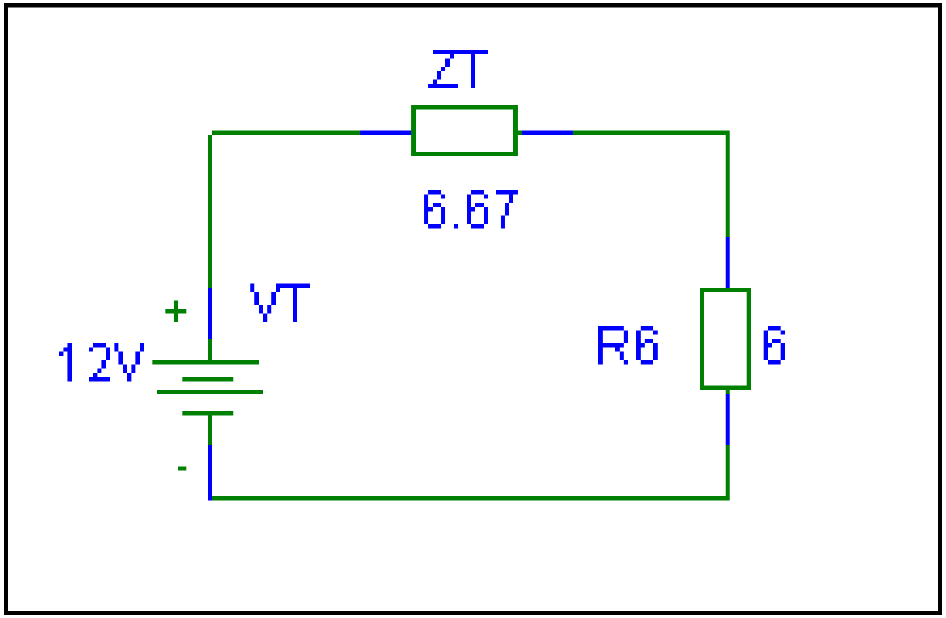
3. Adım Rth

- **1/R = 1/R1 + 1/R2 → R = 2.67.**
- **RA +R = 6.67 Ω →Rth**



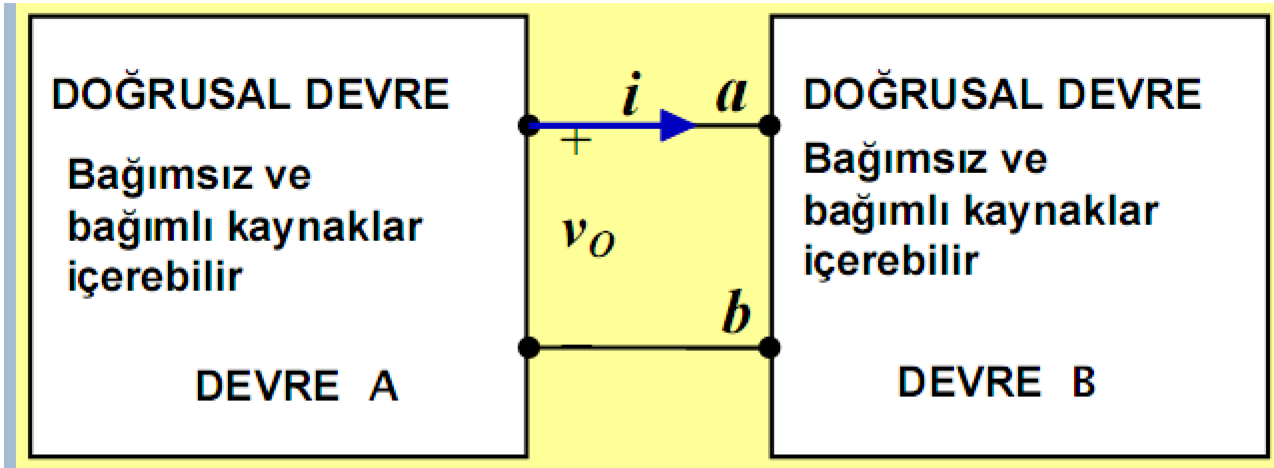
4. Adım Eşdeğer Devre ile hesap

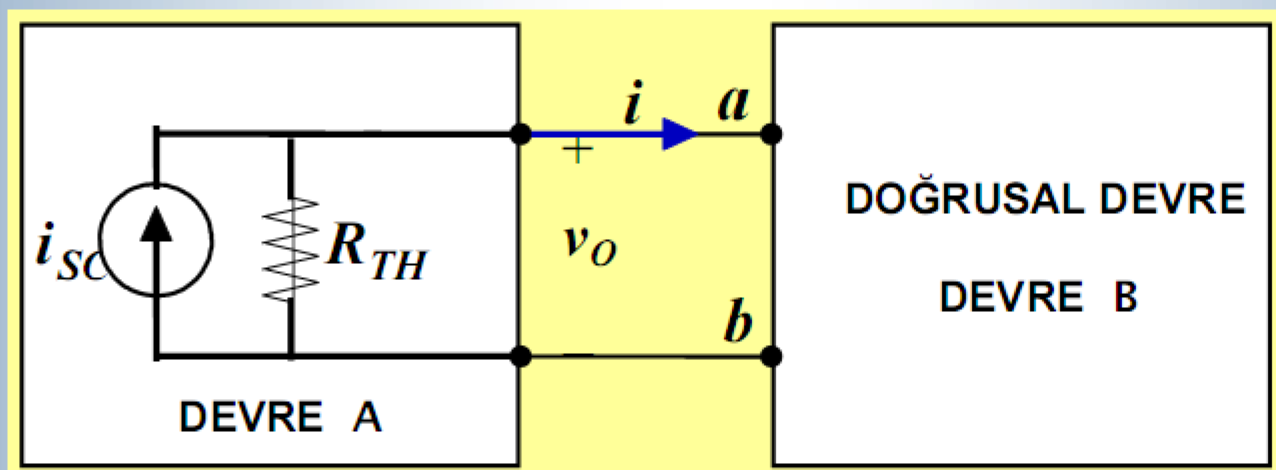
- **R6 => I = VT/Reş = 12/(6.67 + 6) = 0.94 Amps**



Norton Teoremi

- Norton teoremi, elektrik devrelerinin çözümlenmesinin kolaylaştırılması için kullanılan teorem ve yöntemdir. Bu yöntem sayesinde karmaşık elektrik devreler oluşturulan basit eşdeğer devre üzerinden kolayca çözülebilir.
- Norton Teoremi, benzer bir yöntem olan Thevenin teoreminin uzantısıdır. Teorem 1926 yılında birbirinden bağımsız olarak; Siemens firmasından Hans Ferdinand Mayer (1895-1980) ve Bell Laboratuvarları'dan Edward Lawry Norton (1898-1983) tarafından geliştirilmiştir. Mayer konu ile ilgili çalışmasını yayımlamış, Norton'un çalışması ise firma içi teknik rapor olarak kalmıştır.
- Doğrusal bir devre, herhangi iki noktasına göre, bir akım kaynağı ve buna paralel bir direnç haline getirilebilir.
- Bunun için;
  - Herhangi iki noktadan uçları kısa devre edildiğinde geçen akım kaynak akımıdır
  - Gerilim kaynağı kısa devre edildiğinde, iki nokta arasındaki direnç eşdeğer dirençtir.





Norton Eşdeğer Devresi

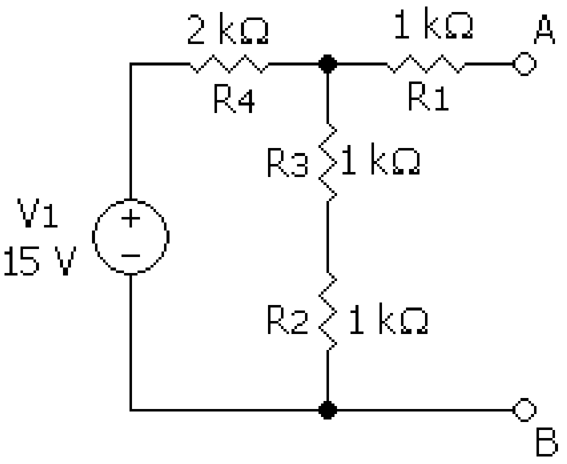
DEVRE A için

i_{SC} Norton Esdeger Kaynagi

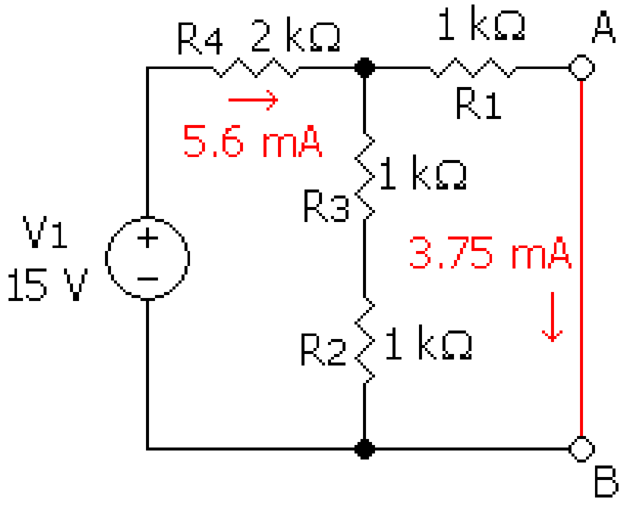
R_{TH} Thevenin Esdeger Direnci

Norton Örnek

- Norton Eşdeğerini bulunuz?



Norton Akımı ?

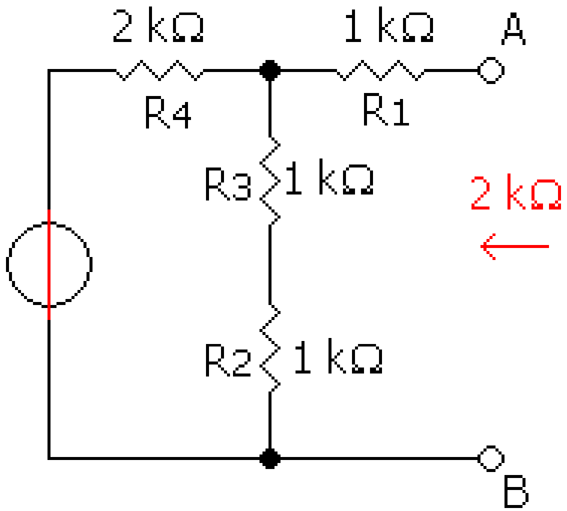


$$I_{\text{total}} = \frac{15\text{V}}{2\,\text{k}\Omega + 1\,\text{k}\Omega \| (1\,\text{k}\Omega + 1\,\text{k}\Omega)} = 5.625\text{mA}$$

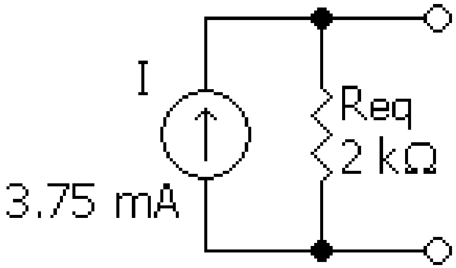
$$I = \frac{1\,\text{k}\Omega + 1\,\text{k}\Omega}{(1\,\text{k}\Omega + 1\,\text{k}\Omega + 1\,\text{k}\Omega)} \cdot I_{\text{total}}$$

$$= 2/3 \cdot 5.625\text{mA} = 3.75\text{mA}$$

Norton Direnci =Rth



$$R = 1\,\mathrm{k\Omega} + 2\,\mathrm{k\Omega} \| (1\,\mathrm{k\Omega} + 1\,\mathrm{k\Omega}) = 2\,\mathrm{k\Omega}$$



Norton⇔Thevenin

- Ohm kanunu

$$R_{Th} = R_{No}$$

$$V_{Th} = I_{No} R_{No}$$

$$V_{Th} / R_{Th} = I_{No}$$