

# Elektrik Devre Temelleri

2024-2025 Bahar Dönemi

Hafta 10

25 Nisan 2025

Sibel ÇİMEN

Umut Engin AYTEN

# ELEKTRİK DEVRELERİ

## 1. Direnç Devreleri

İçinde endüktans ve kapasite elemanı bulundurmayan devrelerdir. Bu tür devrelere belleksiz devreler de denir. Direnç devrelerinden elde edilen devre denklemleri cebirseldir.

## 2. Dinamik Devreler

İçinde en az bir kapasite veya endüktans elemanı bulunduran devrelere denir. Dinamik devrelerden elde edilen devre denklemleri diferansiyel veya integro-diferansiyel denklemlerdir.

## 3. Lineer Devreler

Çarpımsallık ve toplamsallık özelliğini sağlayan devrelere denir.



# ELEKTRİK DEVRELERİ

## 4. Lineer Zamanla Değişen ve Zamanla Değişmeyen Devreler

Bağımsız kaynaklar hariç bir devredeki tüm elemanlar lineer ve en az bir eleman zamanla değişiyorsa bu devrelere lineer zamanla değişen devreler, aksi takdirde lineer zamanla değişmeyen devreler (linear time invariant circuit) denir.

## 5. Nonlinear Zamanla Değişen ve Zamanla Değişmeyen Devreler

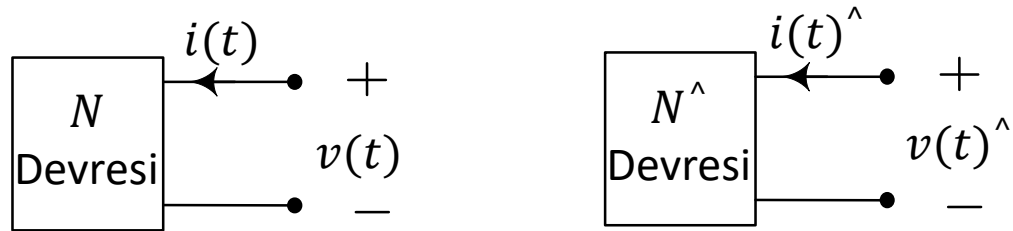
Bağımsız kaynaklar hariç bir devredeki en az bir eleman nonlinear ve en az bir eleman zamanla değişiyorsa bu devrelere nonlinear zamanla değişen devreler, aksi takdirde nonlinear zamanla değişmeyen devreler

## 6. Pasif ve Aktif Devreler

Eğer her  $t$  anı için enerjisi  $W(t) \geq 0$  ise pasif devre denir. Eğer en az bir  $t$  anı için enerjisi  $W(t) < 0$  ise aktif devre denir.

# ELEKTRİK DEVRELERİ

## EŞDEĞER DEVRELER ve EŞDEĞERLİK KAVRAMI

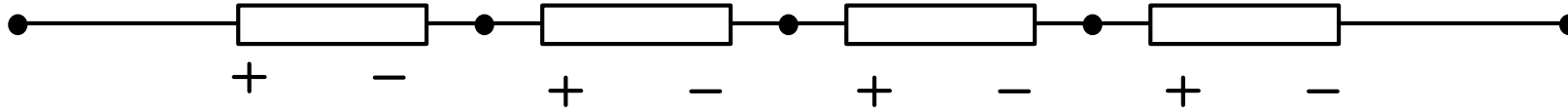


$N$  ve  $N^{\wedge}$  devreleri topolojik olarak birbirinden farklı olabilecek olan devreler olmak üzere;

$i(t) = i(t)^{\wedge}$      $v(t) = v(t)^{\wedge}$     ise bu iki devre birbirinin eşdeğeridir.

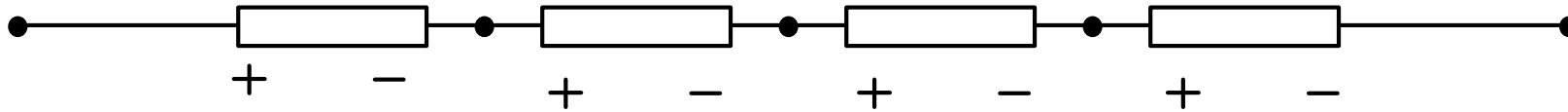
# Seri ve Paralel Direnç Kombinasyonları

+ ve – uçlarından sıralı olarak birbirine bağlanan elemanlar seri bağlıdır.

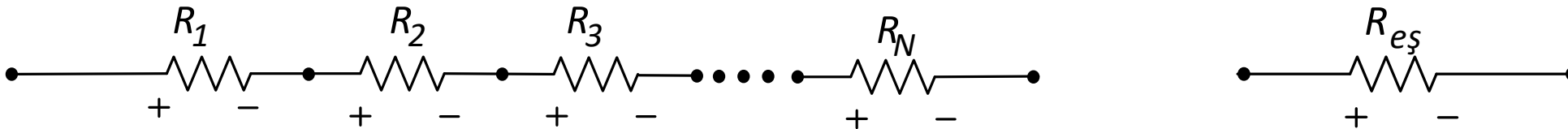


# Seri ve Paralel Direnç Kombinasyonları

+ ve – uçlarından sıralı olarak birbirine bağlanan elemanlar seri bağlıdır.



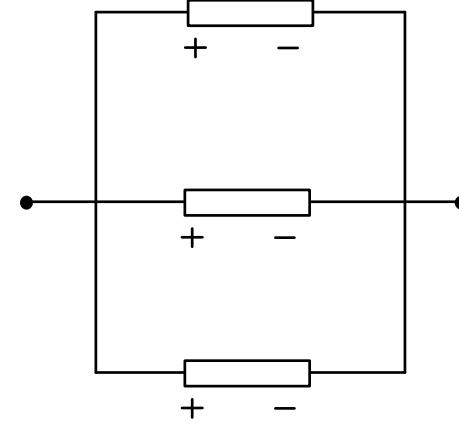
N adet seri bağlı direncin eşdeğeri;



$$R_{eş} = \sum_{k=1}^N R_k = R_1 + R_2 + R_3 + \cdots + R_N$$

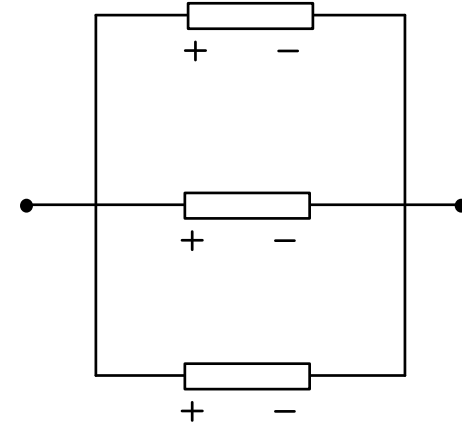
# Seri ve Paralel Direnç Kombinasyonları

Uçları aynı düğümlere bağlı yani üzerlerinde aynı gerilim olan elemanlar paralel bağlıdır.

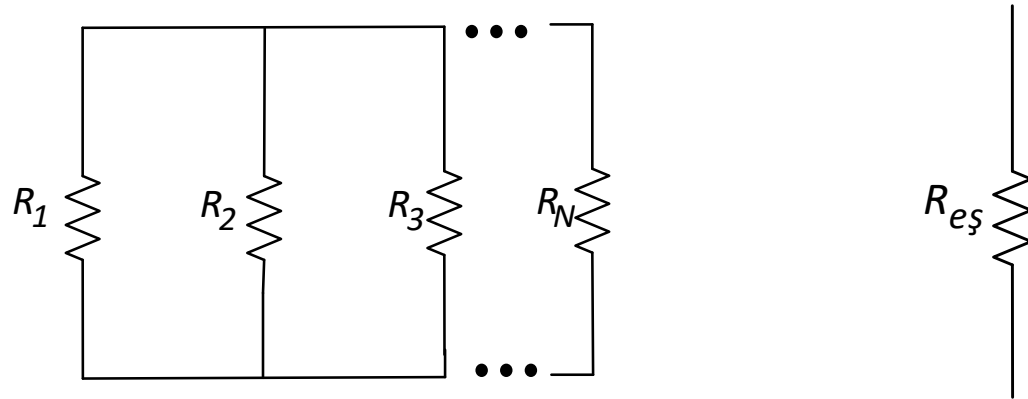


# Seri ve Paralel Direnç Kombinasyonları

Uçları aynı düğümlere bağlı yani üzerlerinde aynı gerilim olan elemanlar paralel bağlıdır.



N adet paralel bağlı direncin eşdeğeri

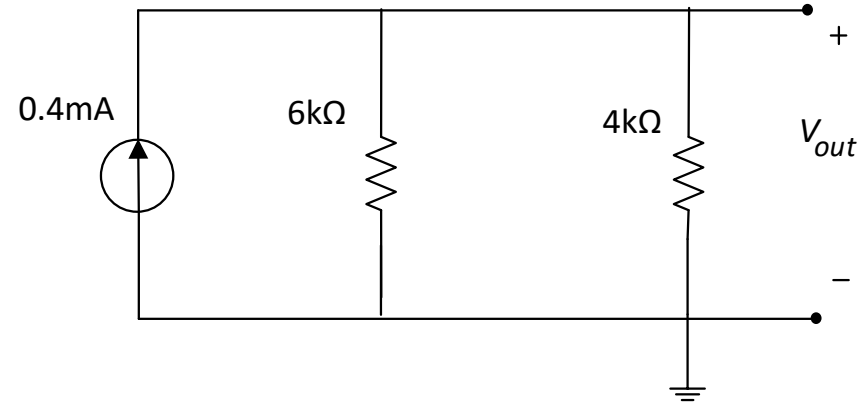


$$\frac{1}{R_{eş}} = \sum_{k=1}^N \frac{1}{R_k} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \dots + \frac{1}{R_N}$$

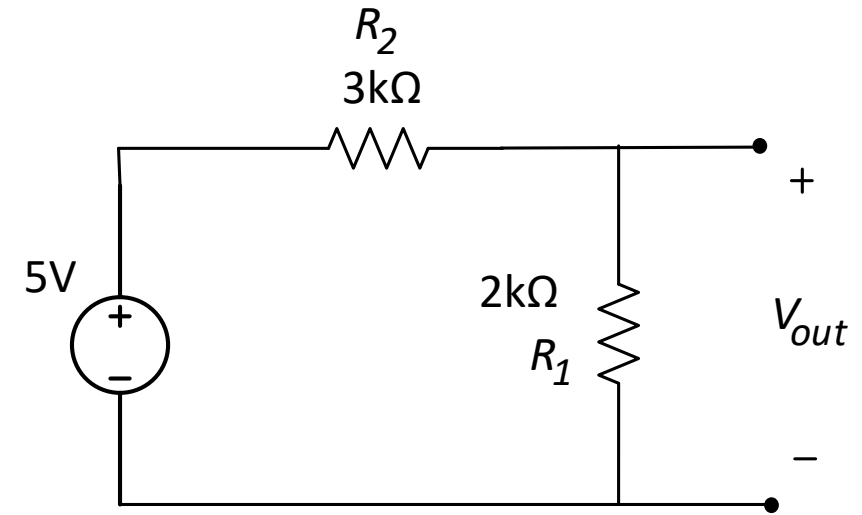
$$G_{eş} = \sum_{k=1}^N G_k = G_1 + G_2 + G_3 + \dots + G_N$$



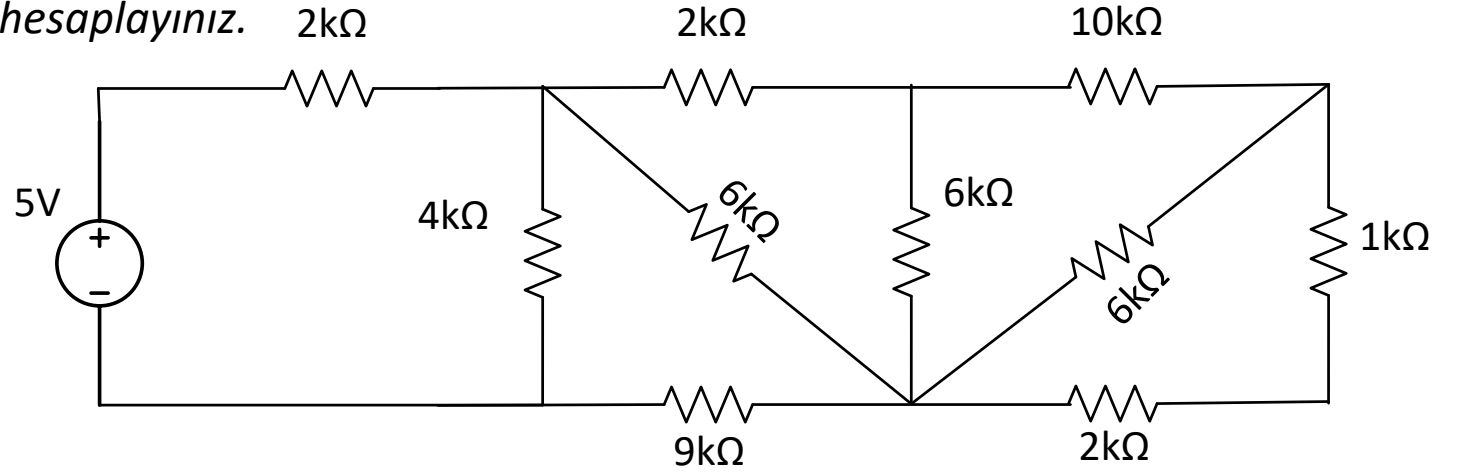
Örnek:  $v_{out}$  gerilimini hesaplayınız.



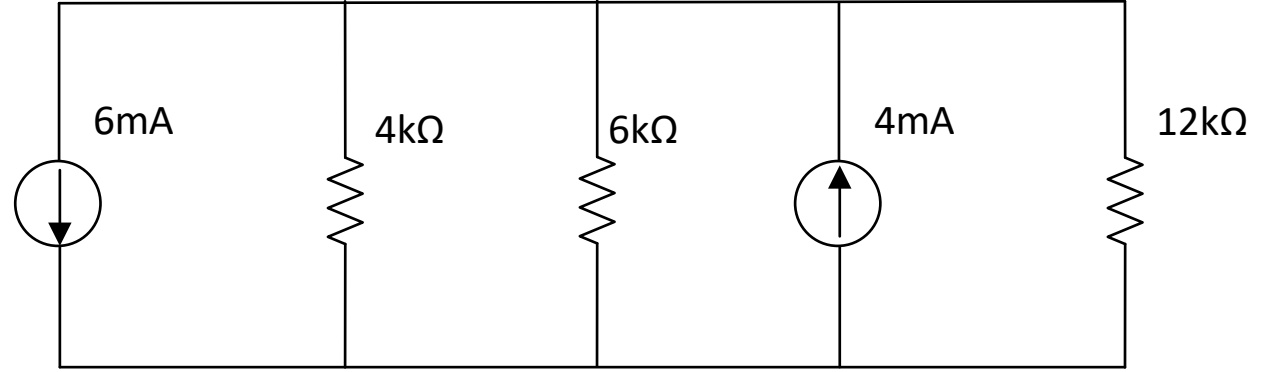
Örnek:  $v_{out}$  gerilimini hesaplayınız.



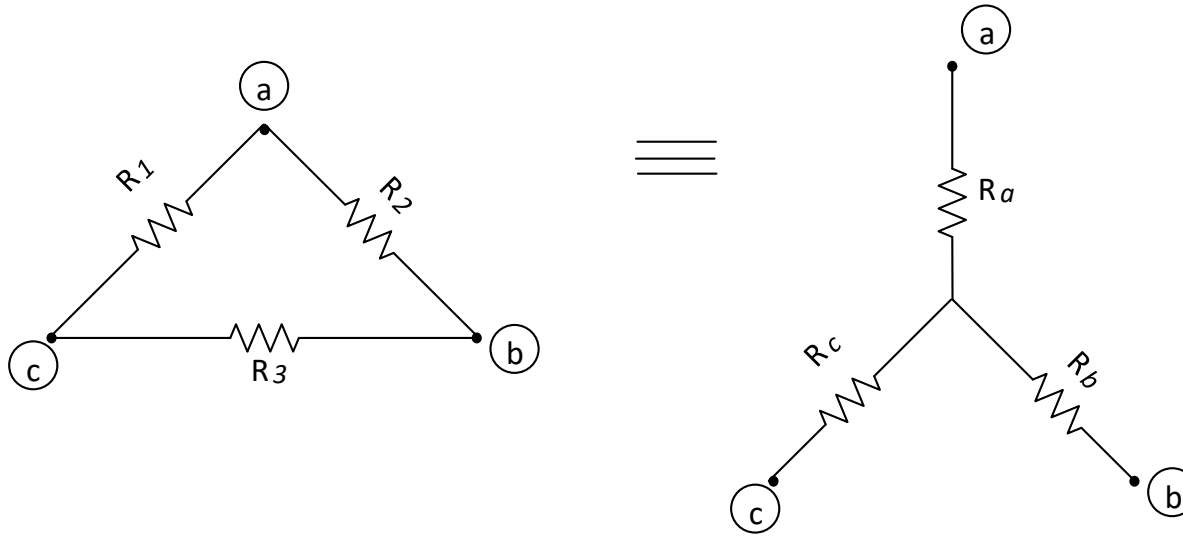
Örnek:  $P_{vk}$  Bağımsız gerilim kaynağının gücünü hesaplayınız.



Örnek:  $P_{4k}$  belirleyiniz.



# Yıldız-Üçgen Dönüşümü

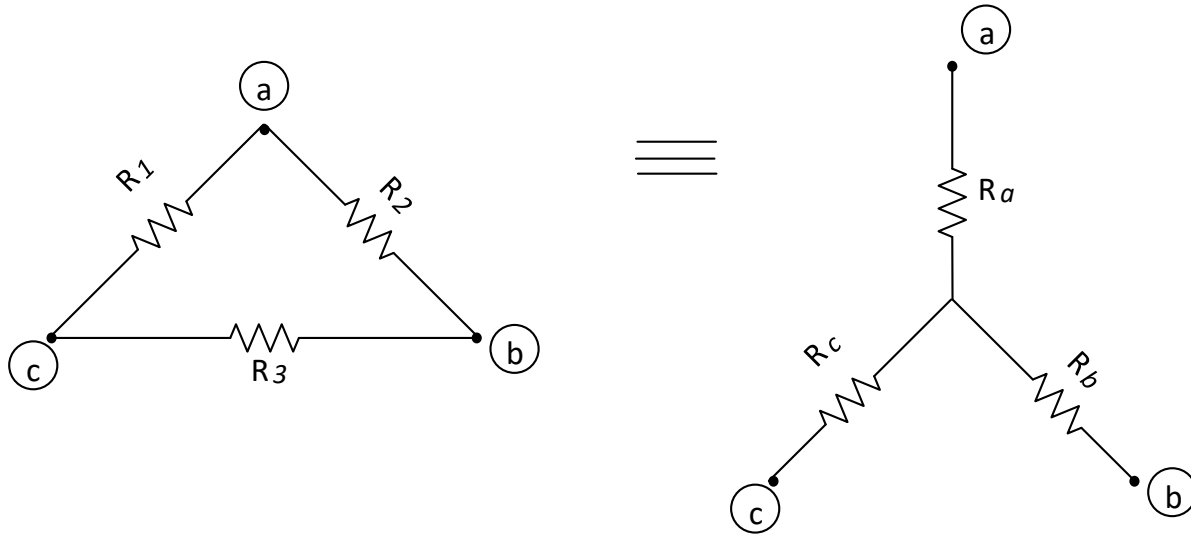


c açık devre iken; (a ve b uçlar)

$$R_{ab} = R_2 \parallel (R_1 + R_3) = R_a + R_b$$

$$R_a + R_b = \frac{R_2(R_1 + R_3)}{R_1 + R_2 + R_3}$$

# Yıldız-Üçgen Dönüşümü

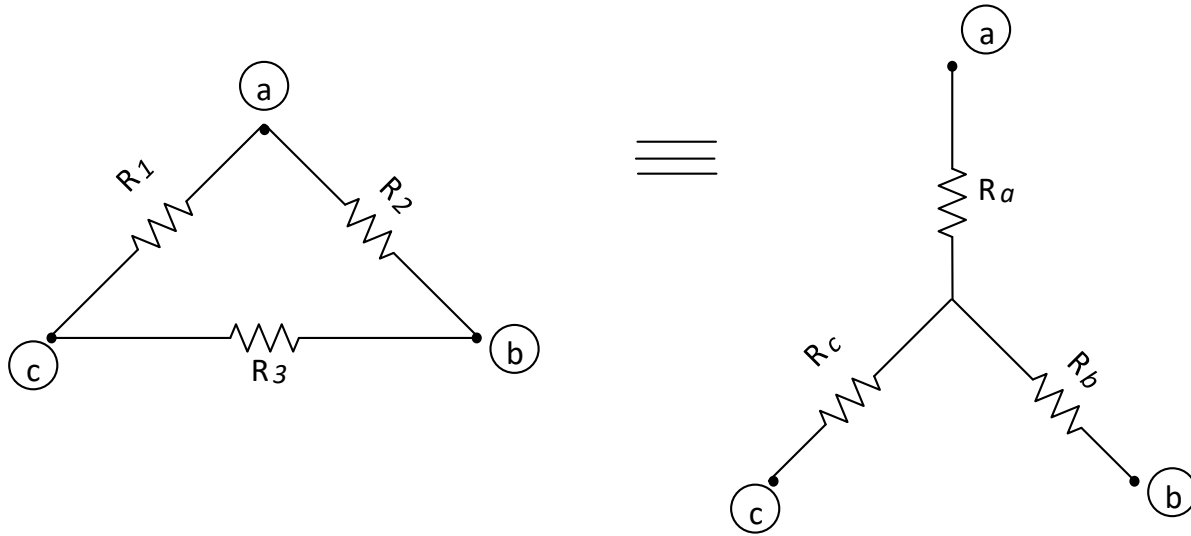


b açık devre iken; (a ve c uçlar)

$$R_{ac} = R_1 \parallel (R_2 + R_3) = R_a + R_c$$

$$R_a + R_c = \frac{R_1(R_2 + R_3)}{R_1 + R_2 + R_3}$$

# Yıldız-Üçgen Dönüşümü

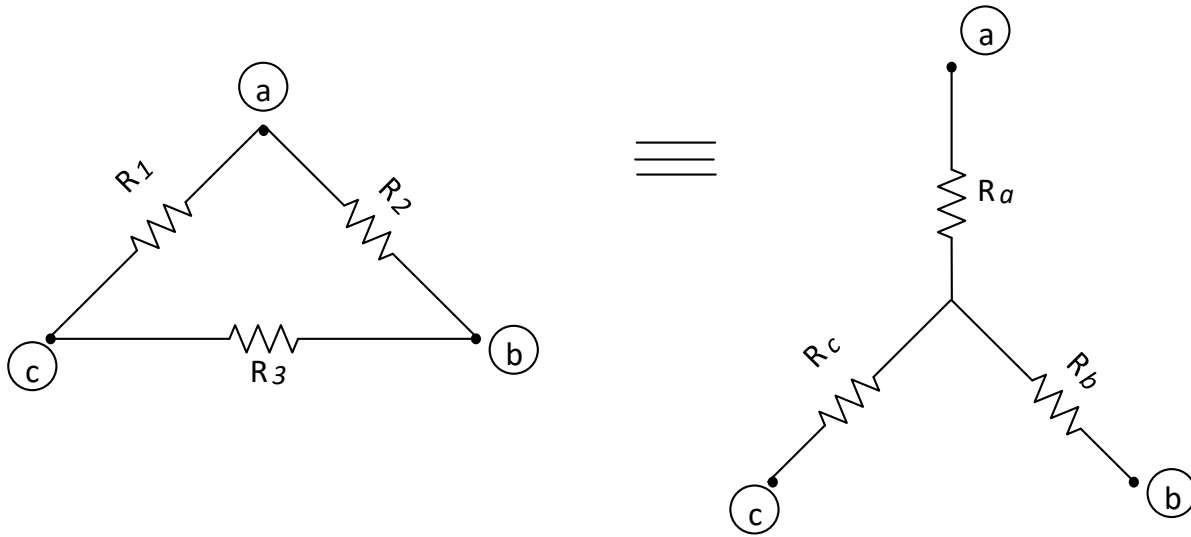


a açık devre iken; (b ve c uçlar)

$$R_{bc} = R_3 \parallel (R_1 + R_2) = R_b + R_c$$

$$R_b + R_c = \frac{R_3(R_1 + R_2)}{R_1 + R_2 + R_3}$$

# Yıldız-Üçgen Dönüşümü



$$R_a = \frac{R_1 R_2}{R_1 + R_2 + R_3}$$

$$R_b = \frac{R_2 R_3}{R_1 + R_2 + R_3}$$

$$R_c = \frac{R_1 R_3}{R_1 + R_2 + R_3}$$

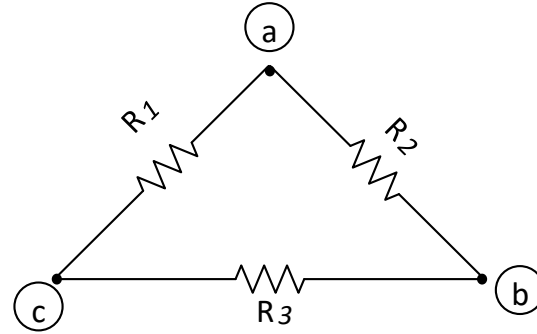


# Yıldız-Üçgen Dönüşümü

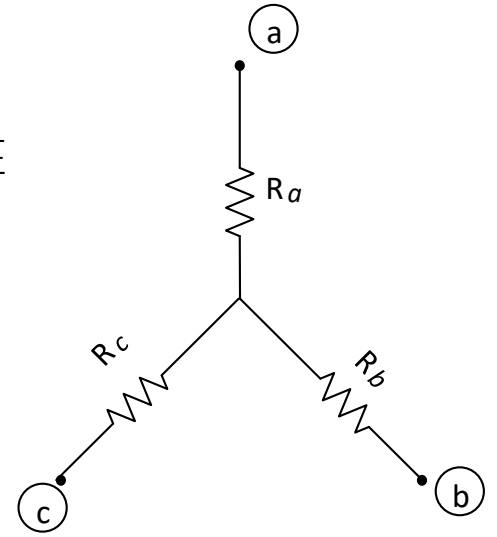
$$R_1 = \frac{R_a R_b + R_b R_c + R_a R_c}{R_b}$$

$$R_2 = \frac{R_a R_b + R_b R_c + R_a R_c}{R_c}$$

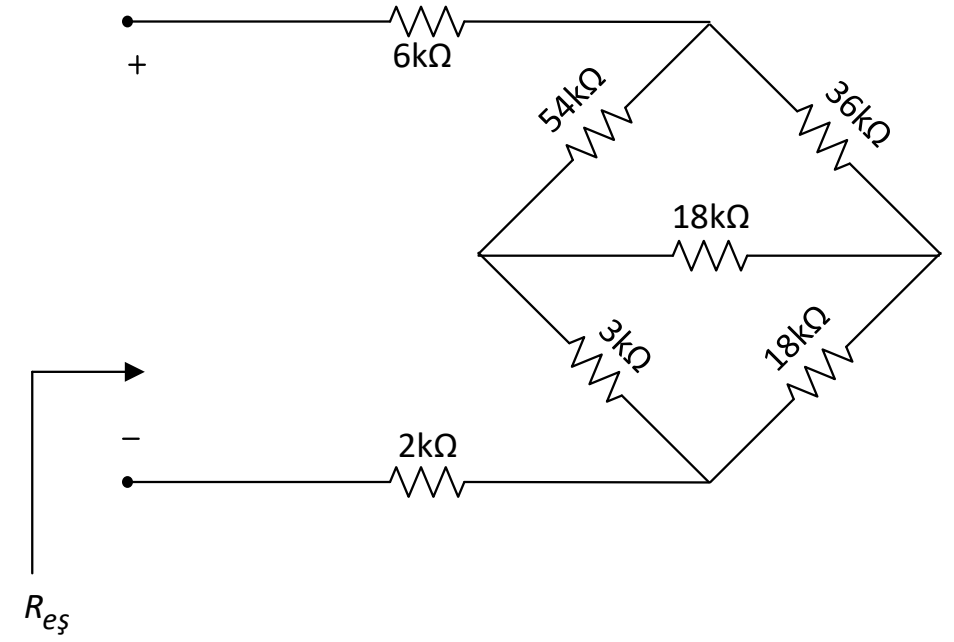
$$R_3 = \frac{R_a R_b + R_b R_c + R_a R_c}{R_a}$$



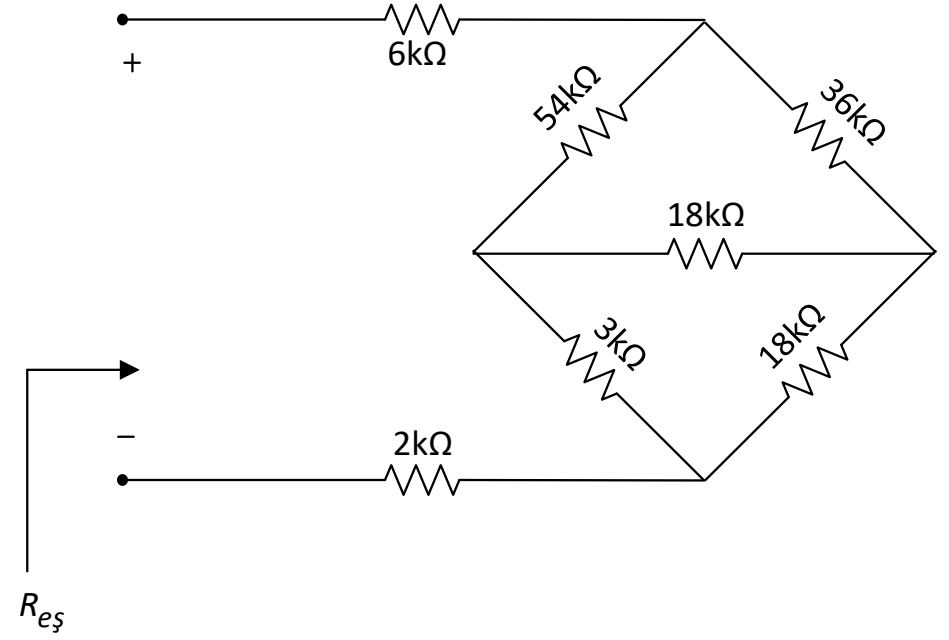
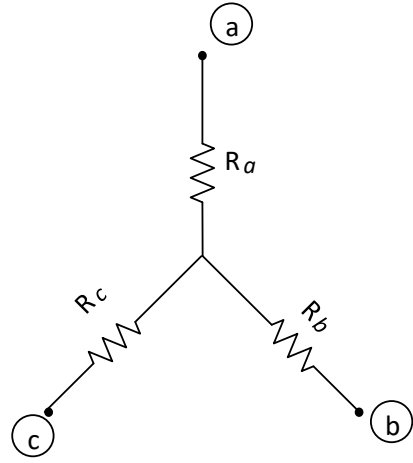
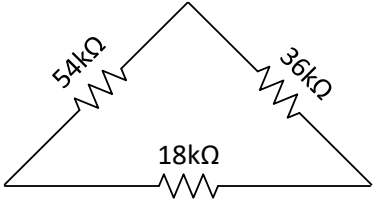
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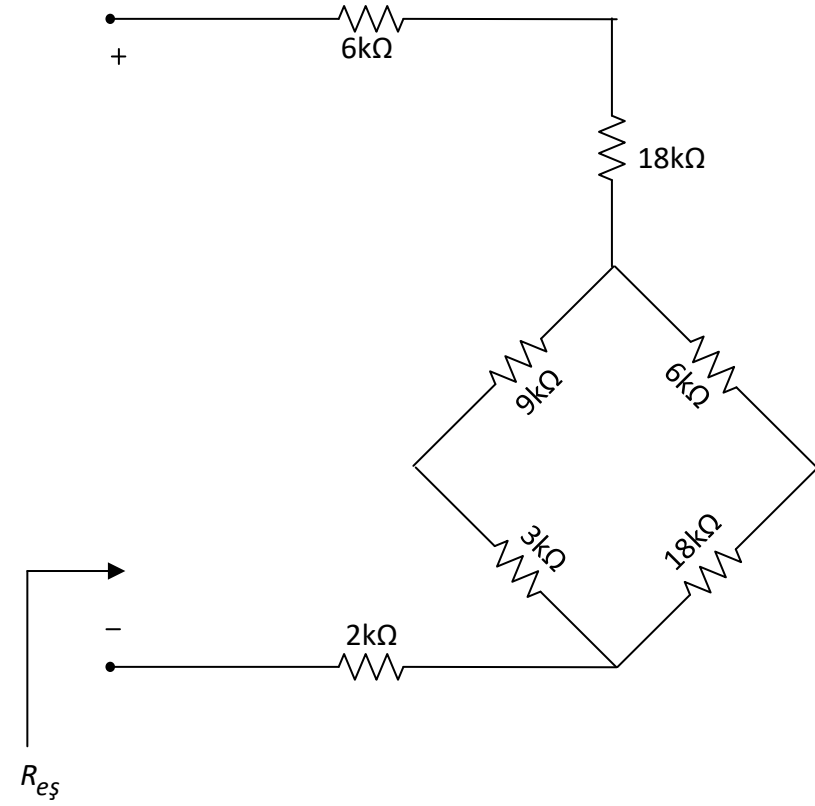
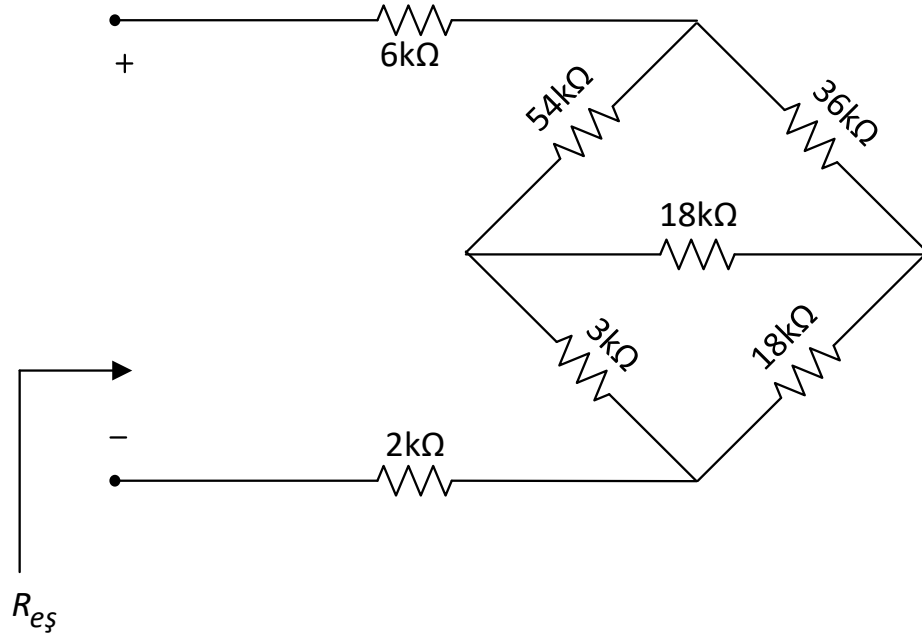
Örnek:  $R_{e\zeta} = ?$



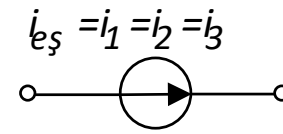
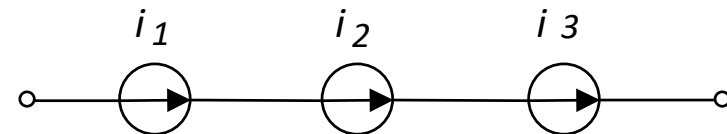
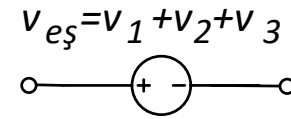
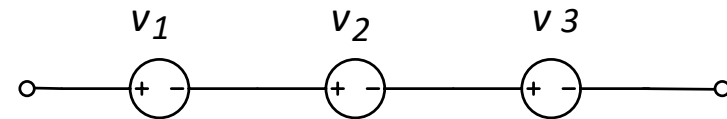
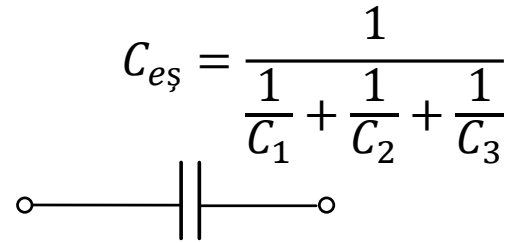
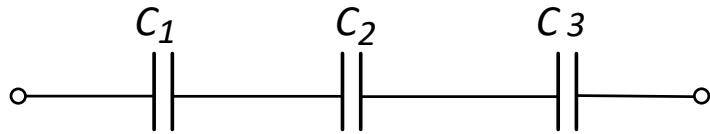
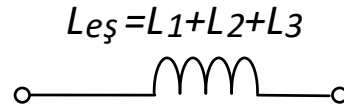
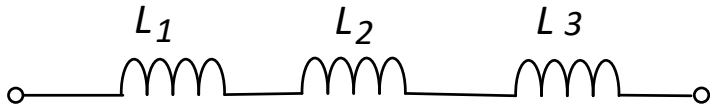
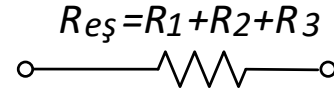
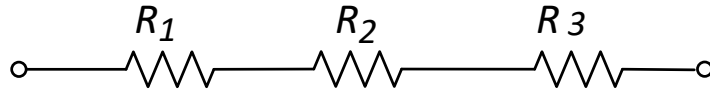
Örnek:  $R_{eş} = ?$



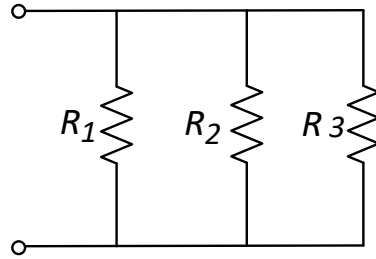
Örnek:  $R_{e\zeta} = ?$



# Devre Elemanlarının Seri Bağlanması

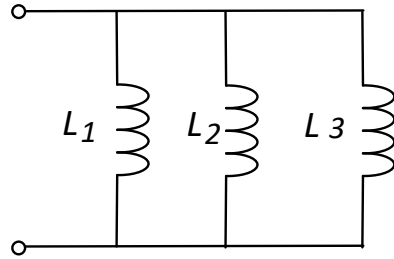


# Devre Elemanlarının Paralel Bağlanması



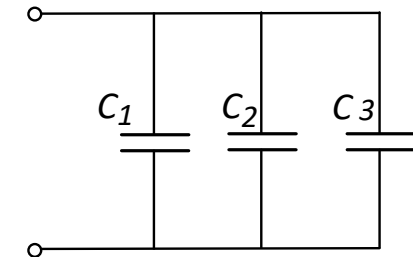
A circuit diagram showing a single equivalent resistor connected between two terminals. To its right is the formula for the equivalent resistance:

$$R_{eş} = \frac{1}{\frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}}$$



A circuit diagram showing a single equivalent inductor connected between two terminals. To its right is the formula for the equivalent inductance:

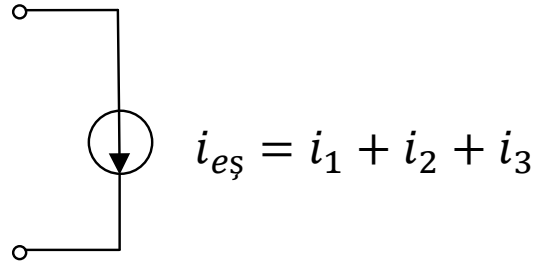
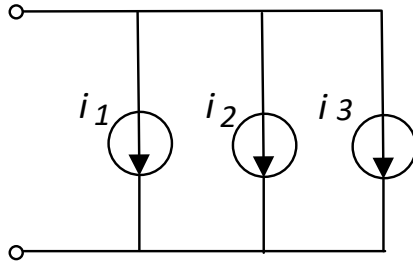
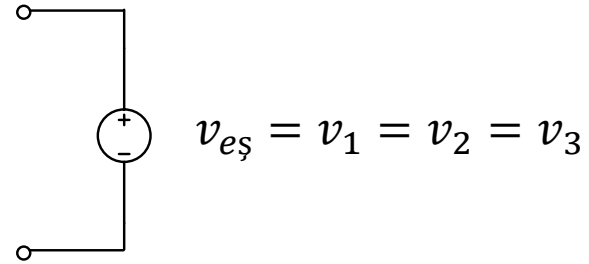
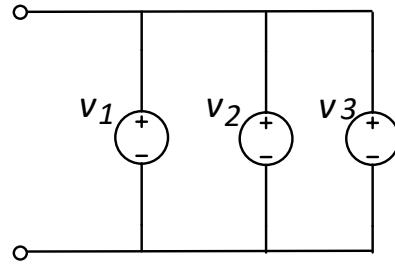
$$L_{eş} = \frac{1}{\frac{1}{L_1} + \frac{1}{L_2} + \frac{1}{L_3}}$$



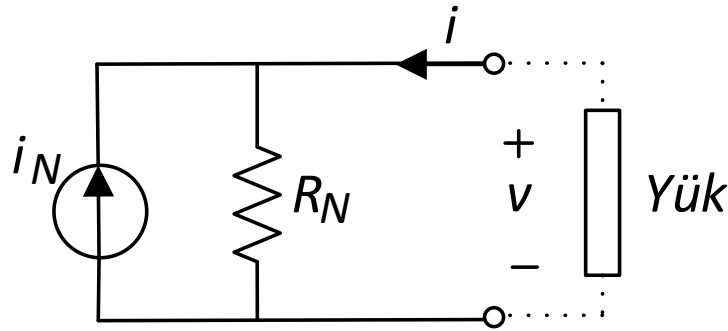
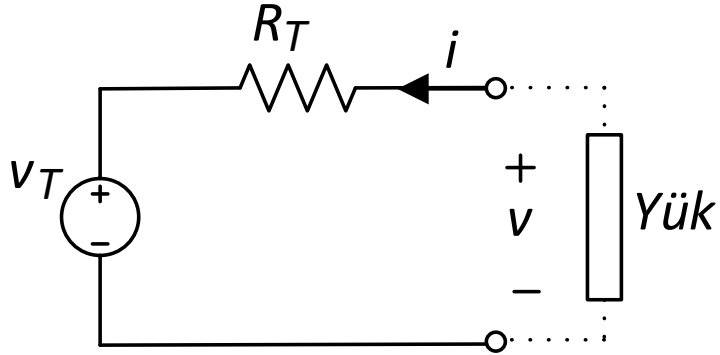
A circuit diagram showing a single equivalent capacitor connected between two terminals. To its right is the formula for the equivalent capacitance:

$$C_{eş} = C_1 + C_2 + C_3$$

# Devre Elemanlarının Paralel Bağlanması



# Eşdeğer Kaynaklar ve Kaynak Dönüşümü



Bu iki devrenin eşdeğer olabilmesi için;

$$R_T = R_N$$

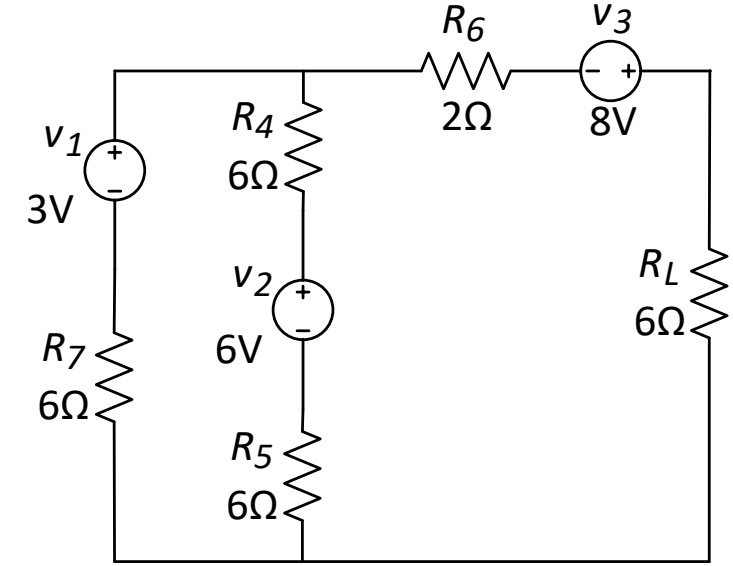
$$v_T = R_N i_N$$



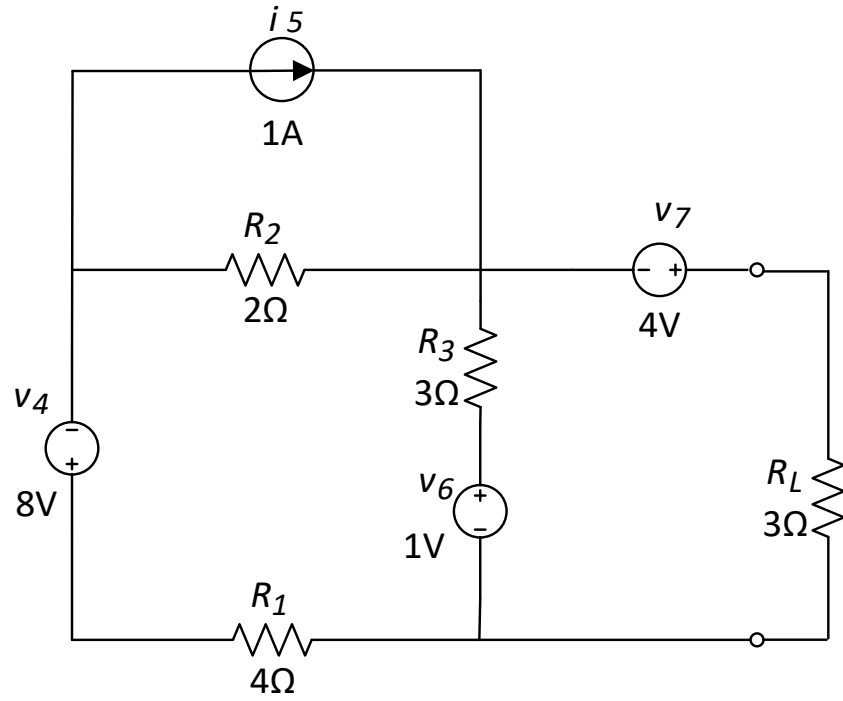
Örnek: Verilen devrenin kaynak dönüşümleri üzerinden çözümünü gerçekleştiriniz.

a.  $R_L$  üzerinden geçen akımı hesaplayınız.

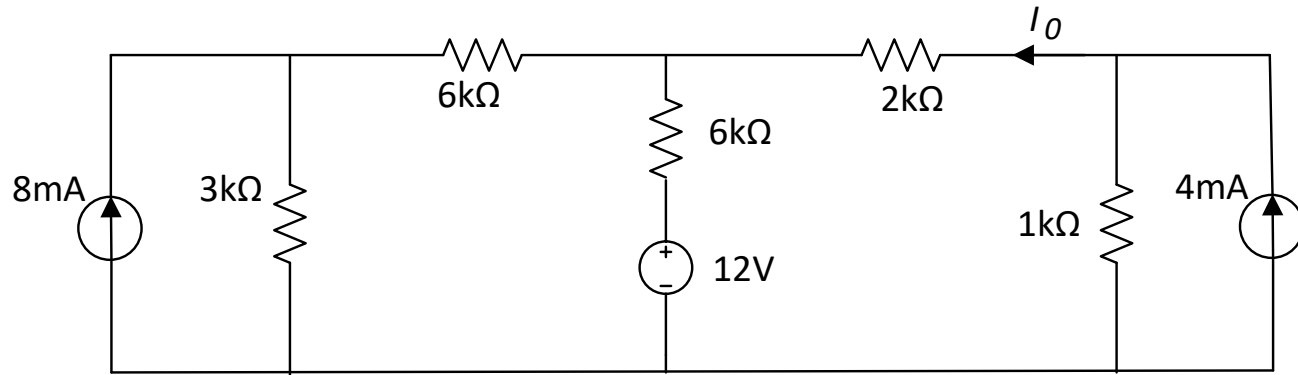
b.  $p_L = ?$



Örnek: Verilen devrenin Norton eşdeğerini bulunuz.



Örnek: Kaynak dönüşümünden faydalananarak  $I_0$  akımını bulunuz.



Ödev 2 Verilecek!

Teslim Tarihi: 09.05.2025, saat: 23:45