

# **Esercizi di Elettrotecnica**

**Circuiti in corrente continua**

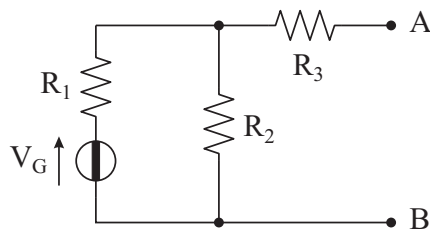
**Parte 3**

*Bipoli equivalenti di Thévenin e Norton*

[www.die.ing.unibo.it/pers/mastri/didattica.htm](http://www.die.ing.unibo.it/pers/mastri/didattica.htm)

(versione del 9-6-2006)



**Esercizio n. 1**

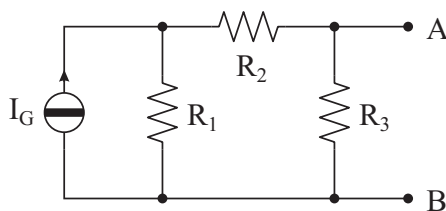
$$\begin{aligned} R_1 &= 4 \, \Omega \\ R_2 &= 12 \, \Omega \\ R_3 &= 6 \, \Omega \\ V_G &= 24 \, \text{V} \end{aligned}$$

Determinare i parametri dei bipoli equivalenti di Thévenin e Norton del bipolo A-B.

**Risultati**

$$V_0 = 18 \, \text{V} \qquad R_{\text{eq}} = 9 \, \Omega \qquad I_{\text{cc}} = 2 \, \text{A}$$


---

**Esercizio n. 2**

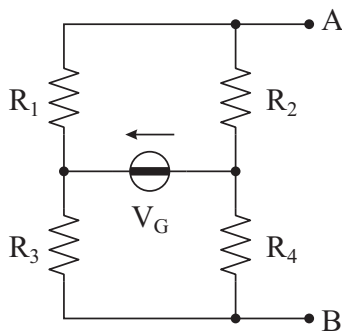
$$\begin{aligned} R_1 &= 6 \, \Omega \\ R_2 &= 2 \, \Omega \\ R_3 &= 8 \, \Omega \\ I_G &= 4 \, \text{A} \end{aligned}$$

Determinare i parametri dei bipoli equivalenti di Thévenin e Norton del bipolo A-B.

**Risultati**

$$V_0 = 12 \, \text{V} \qquad R_{\text{eq}} = 4 \, \Omega \qquad I_{\text{cc}} = 3 \, \text{A}$$


---

**Esercizio n. 3**

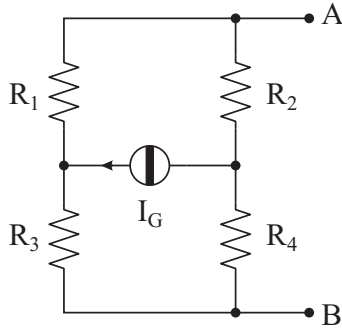
$$\begin{aligned} R_1 &= 20 \, \Omega \\ R_2 &= 20 \, \Omega \\ R_3 &= 60 \, \Omega \\ R_4 &= 20 \, \Omega \\ V_G &= 100 \, \text{V} \end{aligned}$$

Determinare i parametri dei bipoli equivalenti di Thévenin e Norton del bipolo A-B.

**Risultati**

$$V_0 = 25 \, \text{V} \qquad R_{\text{eq}} = 25 \, \Omega \qquad I_{\text{cc}} = 1 \, \text{A}$$


---

**Esercizio n. 4**

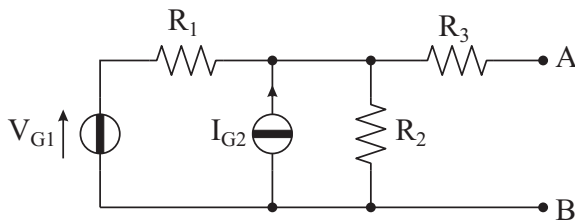
$$\begin{aligned} R_1 &= 20 \, \Omega \\ R_2 &= 15 \, \Omega \\ R_3 &= 10 \, \Omega \\ R_4 &= 5 \, \Omega \\ I_G &= 6 \, \text{A} \end{aligned}$$

Determinare i parametri dei bipoli equivalenti di Thévenin e Norton del bipolo A-B.

**Risultati**

$$V_0 = 6 \, \text{V} \qquad R_{\text{eq}} = 12 \, \Omega \qquad I_{\text{cc}} = 0.5 \, \text{A}$$


---

**Esercizio n. 5**

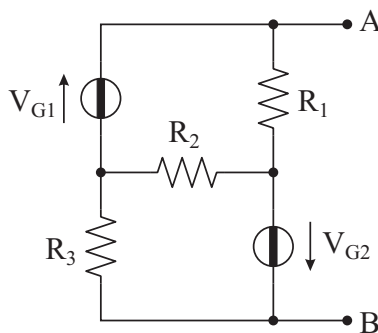
$$\begin{aligned} R_1 &= 15 \, \Omega \\ R_2 &= 10 \, \Omega \\ R_3 &= 10 \, \Omega \\ V_{G1} &= 30 \, \text{V} \\ I_{G2} &= 2 \, \text{A} \end{aligned}$$

Determinare i parametri dei bipoli equivalenti di Thévenin e Norton del bipolo A-B.

**Risultati**

$$V_0 = 24 \, \text{V} \qquad R_{\text{eq}} = 16 \, \Omega \qquad I_{\text{cc}} = 1.5 \, \text{A}$$


---

**Esercizio n. 6**

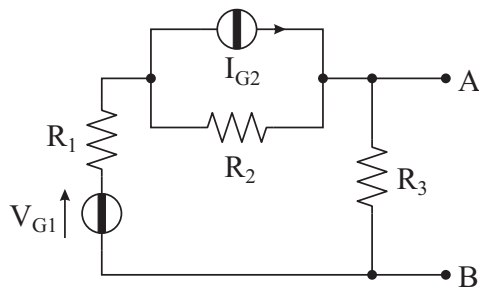
$$\begin{aligned} R_1 &= 9 \, \Omega \\ R_2 &= 18 \, \Omega \\ R_3 &= 6 \, \Omega \\ V_{G1} &= 30 \, \text{V} \\ V_{G2} &= 10 \, \text{V} \end{aligned}$$

Determinare i parametri dei bipoli equivalenti di Thévenin e Norton del bipolo A-B.

**Risultati**

$$V_0 = 15 \, \text{V} \qquad R_{\text{eq}} = 3 \, \Omega \qquad I_{\text{cc}} = 5 \, \text{A}$$


---

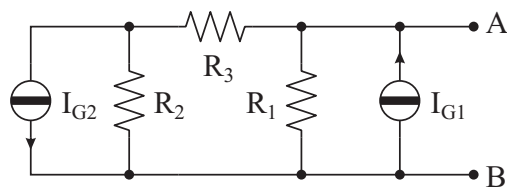
**Esercizio n. 7**

$$\begin{aligned} R_1 &= 2 \, \Omega \\ R_2 &= 4 \, \Omega \\ R_3 &= 6 \, \Omega \\ V_{G1} &= 12 \, \text{V} \\ I_{G2} &= 3 \, \text{A} \end{aligned}$$

Determinare i parametri dei bipoli equivalenti di Thévenin e Norton del bipolo A-B.

**Risultati**

$$V_0 = 12 \, \text{V} \qquad R_{eq} = 3 \, \Omega \qquad I_{cc} = 4 \, \text{A}$$

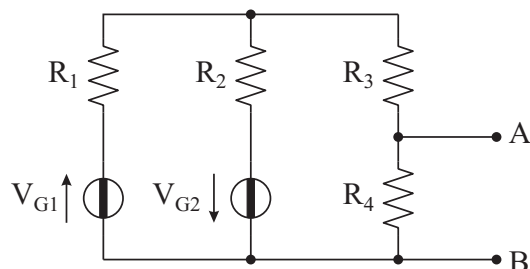
**Esercizio n. 8**

$$\begin{aligned} R_1 &= 5 \, \Omega \\ R_2 &= 10 \, \Omega \\ R_3 &= 10 \, \Omega \\ I_{G1} &= 4 \, \text{A} \\ I_{G2} &= 2 \, \text{A} \end{aligned}$$

Determinare i parametri dei bipoli equivalenti di Thévenin e Norton del bipolo A-B.

**Risultati**

$$V_0 = 12 \, \text{V} \qquad R_{eq} = 4 \, \Omega \qquad I_{cc} = 3 \, \text{A}$$

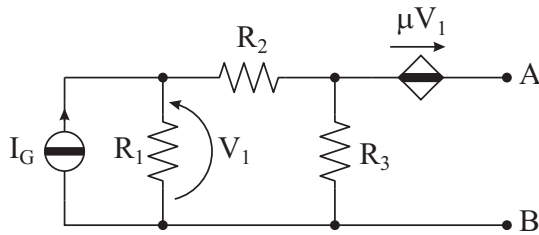
**Esercizio n. 9**

$$\begin{aligned} R_1 &= 6 \, \Omega \\ R_2 &= 12 \, \Omega \\ R_3 &= 4 \, \Omega \\ R_4 &= 8 \, \Omega \\ V_{G1} &= 30 \, \text{V} \\ V_{G2} &= 12 \, \text{V} \end{aligned}$$

Determinare i parametri dei bipoli equivalenti di Thévenin e Norton del bipolo A-B.

**Risultati**

$$V_0 = 8 \, \text{V} \qquad R_{eq} = 4 \, \Omega \qquad I_{cc} = 2 \, \text{A}$$

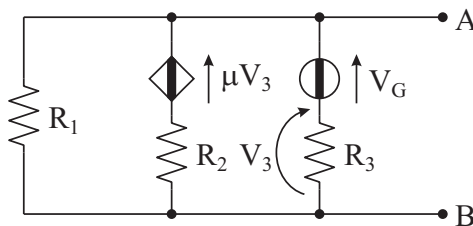
**Esercizio n. 10**

$$R_1 = R_2 = R_3 = R$$

Noti  $R$ ,  $\mu$  e  $I_G$ , determinare i parametri dei bipoli equivalenti di Thévenin e Norton del bipolo A-B.

**Risultati**

$$V_0 = RI_G(1+2\mu)/3 \quad R_{eq} = R(2+\mu)/3 \quad I_{cc} = I_G(1+2\mu)/(2+\mu)$$

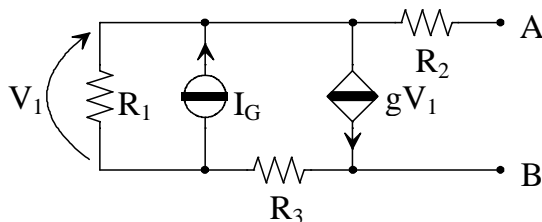
**Esercizio n. 11**

$$R_1 = R_2 = R_3 = R$$

Noti  $R$ ,  $\mu$  e  $V_G$ , determinare i parametri dei bipoli equivalenti di Thévenin e Norton del bipolo A-B.

**Risultati**

$$V_0 = V_G(1-\mu)/(3-\mu) \quad R_{eq} = R/(3-\mu) \quad I_{cc} = V_G(1-\mu)/R$$

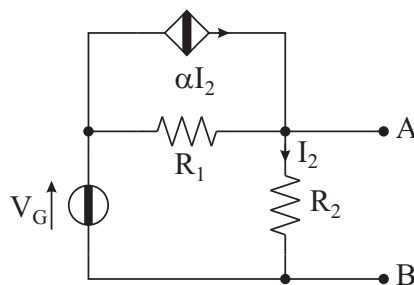
**Esercizio n. 12**

$$R_1 = R_2 = R_3 = R$$

Noti  $R$ ,  $g$  e  $I_G$ , determinare i parametri dei bipoli equivalenti di Thévenin e Norton del bipolo A-B.

**Risultati**

$$V_0 = RI_G(1-gR)/(1+gR) \quad R_{eq} = R(3+gR)/(1+gR) \quad I_{cc} = I_G(1-gR)/(3+gR)$$

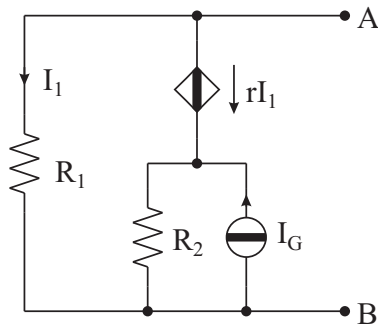
**Esercizio n. 13**

$$\begin{aligned} R_1 &= 2 \, \Omega \\ R_2 &= 8 \, \Omega \\ \alpha &= 3 \\ V_G &= 12 \, \text{V} \end{aligned}$$

Determinare i parametri dei bipoli equivalenti di Thévenin e Norton del bipolo A-B.

**Risultati**

$$V_0 = 24 \, \text{V} \quad R_{eq} = 4 \, \Omega \quad I_{cc} = 6 \, \text{A}$$

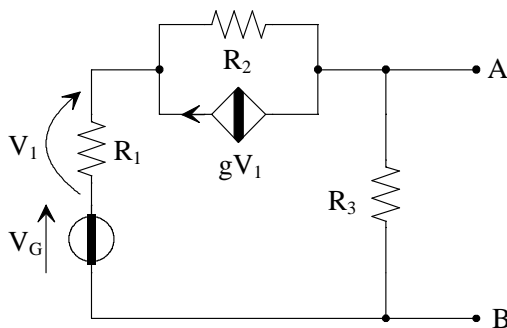
**Esercizio n. 14**

$$\begin{aligned} R_1 &= 4 \, \Omega \\ R_2 &= 8 \, \Omega \\ r &= 4 \\ I_G &= 2 \, \text{A} \end{aligned}$$

Determinare i parametri dei bipoli equivalenti di Thévenin e Norton del bipolo A-B.

**Risultati**

$$V_0 = 4 \, \text{V} \qquad R_{\text{eq}} = 2 \, \Omega \qquad I_{\text{cc}} = 2 \, \text{A}$$

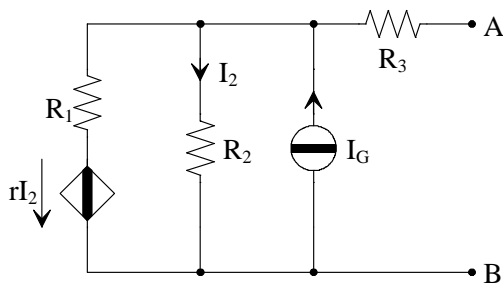
**Esercizio n. 15**

$$\begin{aligned} R_1 &= R \\ R_2 &= R_3 = 2R \end{aligned}$$

Noti  $R$ ,  $g$  e  $V_G$ , determinare i parametri dei bipoli equivalenti di Thévenin e Norton del bipolo A-B.

**Risultati**

$$V_0 = 2V_G/(5-2Rg) \qquad R_{\text{eq}} = 2R(3-2Rg)/(5-2Rg) \qquad I_{\text{cc}} = V_G/[R(3-2Rg)]$$

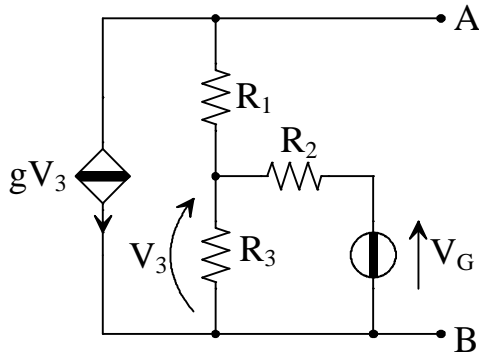
**Esercizio n. 16**

$$\begin{aligned} R_1 &= R \\ R_2 &= R_3 = 2R \end{aligned}$$

Noti  $R$ ,  $r$  e  $I_G$ , determinare i parametri dei bipoli equivalenti di Thévenin e Norton del bipolo A-B.

**Risultati**

$$V_0 = 2R^2 I_G / (3R+r) \qquad R_{\text{eq}} = 2R(4R+r)/(3R+r) \qquad I_{\text{cc}} = R I_G / (4R+r)$$

**Esercizio n. 17**

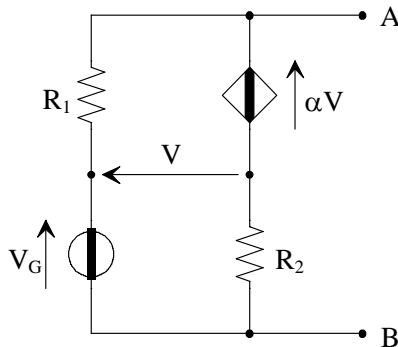
$$R_1 = R_2 = R$$

$$R_3 = 2R$$

Noti  $R$ ,  $g$  e  $V_G$ , determinare i parametri dei bipoli equivalenti di Thévenin e Norton del bipolo A-B.

**Risultati**

$$V_0 = 2V_G(1-gR)/(3+2gR) \quad R_{eq} = 5R/(3+2gR) \quad I_{cc} = 2V_G(1-gR)/5R$$

**Esercizio n. 18**

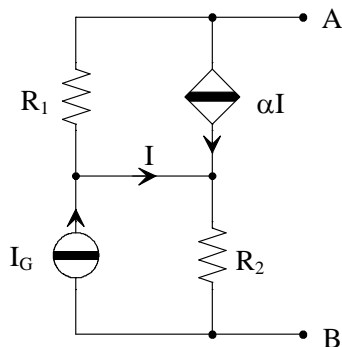
$$R_1 = R$$

$$R_2 = 2R$$

Noti  $R$ ,  $\alpha$  e  $V_G$ , determinare i parametri dei bipoli equivalenti di Thévenin e Norton del bipolo A-B.

**Risultati**

$$V_0 = V_G(2-\alpha)/(3-2\alpha) \quad R_{eq} = 2R(1-\alpha)/(3-2\alpha) \quad I_{cc} = V_G(2-\alpha)/[2R(1-\alpha)]$$

**Esercizio n. 19**

$$R_1 = 2R$$

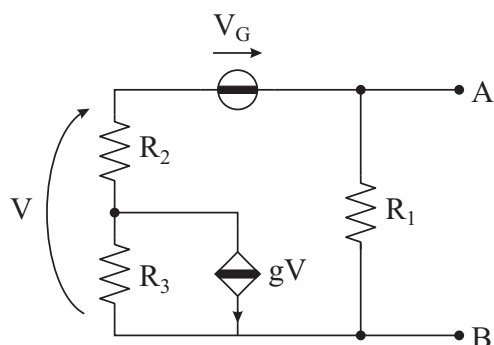
$$R_2 = R$$

Noti  $R$ ,  $\alpha$  e  $I_G$ , determinare i parametri dei bipoli equivalenti di Thévenin e Norton del bipolo A-B.

**Risultati**

$$V_0 = RI_G(1-\alpha)/(1+\alpha) \quad R_{eq} = R(3+\alpha)/(1+\alpha) \quad I_{cc} = I_G(1-\alpha)/(3+\alpha)$$



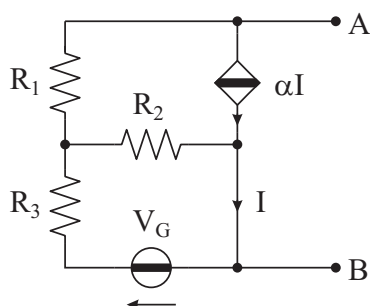
**Esercizio n. 20**

$$\begin{aligned} R_1 &= 30 \, \Omega \\ R_2 &= 20 \, \Omega \\ R_3 &= 10 \, \Omega \\ g &= 0.1 \, \text{S} \\ V_G &= 15 \, \text{V} \end{aligned}$$

Determinare i parametri dei bipoli equivalenti di Thévenin e Norton del bipolo A-B.

**Risultati**

$$V_0 = 10 \, \text{V} \qquad R_{\text{eq}} = 10 \, \Omega \qquad I_{\text{cc}} = 1 \, \text{A}$$

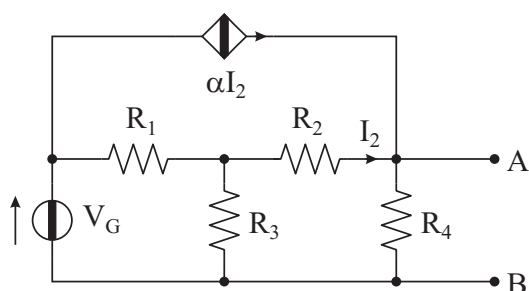
**Esercizio n. 21**

$$\begin{aligned} R_1 &= 10 \, \Omega \\ R_2 &= 10 \, \Omega \\ R_3 &= 10 \, \Omega \\ \alpha &= 3 \\ V_G &= 6 \, \text{V} \end{aligned}$$

Determinare i parametri dei bipoli equivalenti di Thévenin e Norton del bipolo A-B.

**Risultati**

$$V_0 = 30 \, \text{V} \qquad R_{\text{eq}} = 60 \, \Omega \qquad I_{\text{cc}} = 0.5 \, \text{A}$$

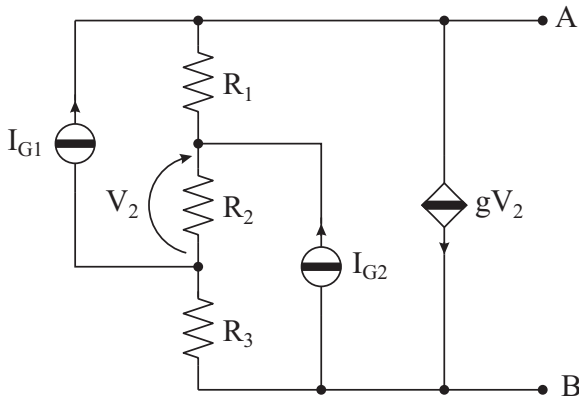
**Esercizio n. 22**

$$\begin{aligned} R_1 &= 9 \, \Omega \\ R_2 &= 9 \, \Omega \\ R_3 &= 9 \, \Omega \\ R_4 &= 9 \, \Omega \\ \alpha &= 2 \\ V_G &= 18 \, \text{V} \end{aligned}$$

Determinare i parametri dei bipoli equivalenti di Thévenin e Norton del bipolo A-B.

**Risultati**

$$V_0 = 6 \, \text{V} \qquad R_{\text{eq}} = 3 \, \Omega \qquad I_{\text{cc}} = 2 \, \text{A}$$

**Esercizio n. 23**

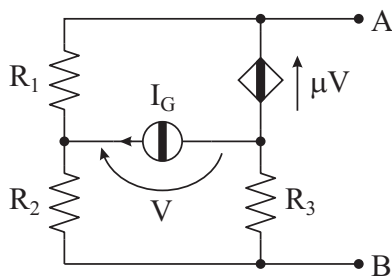
$$R_1 = R_2 = R_3 = R$$

$$I_{G1} = I_{G2} = J$$

Noti  $R$ ,  $g$  e  $J$ , determinare i parametri dei bipoli equivalenti di Thévenin e Norton del bipolo A-B.

**Risultati**

$$V_0 = 2RJ(2-gR)/(1+gR) \quad R_{eq} = 3R/(1+gR) \quad I_{cc} = 2J(2-gR)/3$$

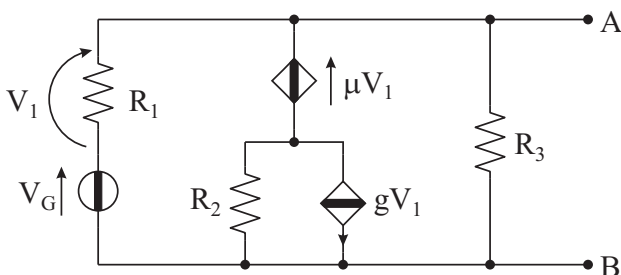
**Esercizio n. 24**

$$R_1 = R_2 = R_3 = R$$

Noti  $R$ ,  $\mu$ , e  $I_G$ , determinare i parametri dei bipoli equivalenti di Thévenin e Norton del bipolo A-B.

**Risultati**

$$V_0 = RI_G(1-2\mu)/(2\mu-3) \quad R_{eq} = 2R(\mu-1)/(2\mu-3) \quad I_{cc} = I_G(1-2\mu)/[2(\mu-1)]$$

**Esercizio n. 25**

$$R_1 = R_2 = R_3 = R$$

Noti  $R$ ,  $\mu$ ,  $g$ , e  $V_G$ , determinare i parametri dei bipoli equivalenti di Thévenin e Norton del bipolo A-B.

**Risultati**

$$V_0 = V_G(gR-\mu+1)/(gR-\mu+3) \quad R_{eq} = R/(gR-\mu+3) \quad I_{cc} = V_G(gR-\mu+1)/R$$