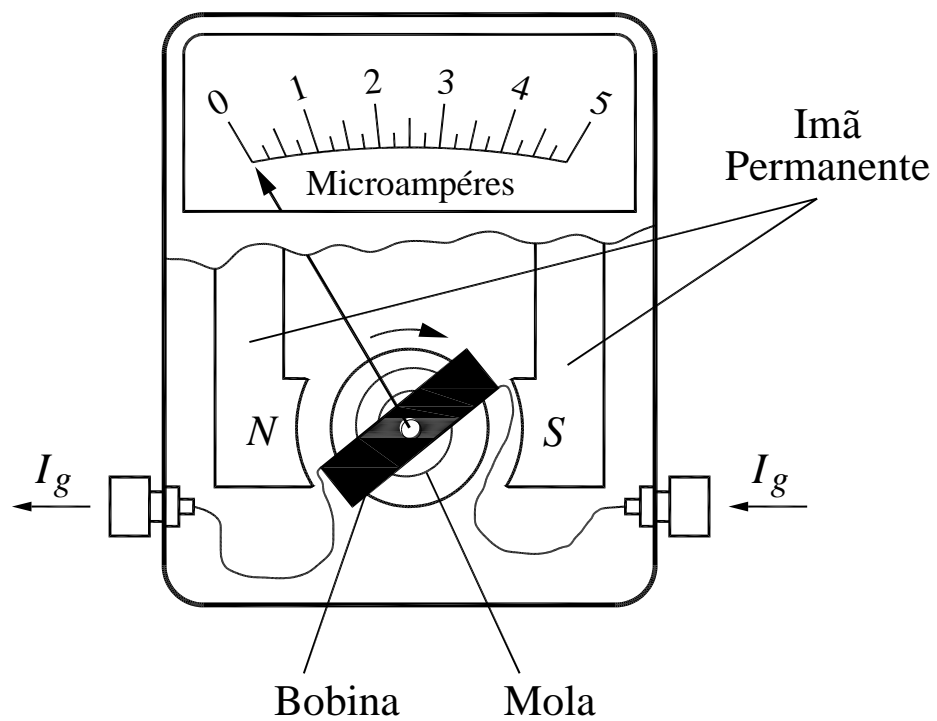


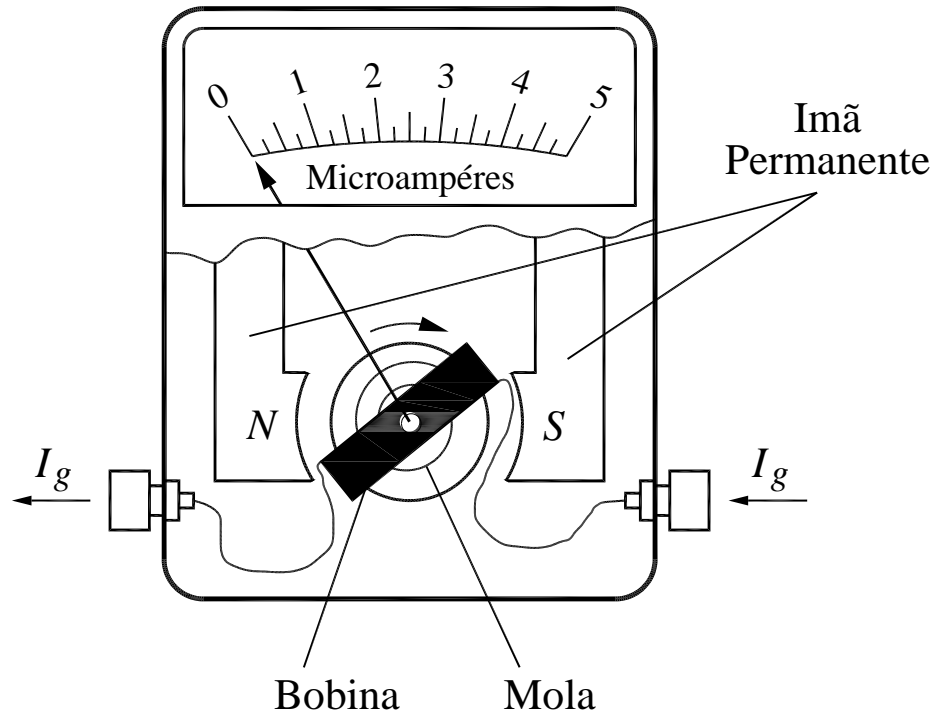
Prática 1 e Simuladores

Hilde Harb Buzzá

Galvanômetro

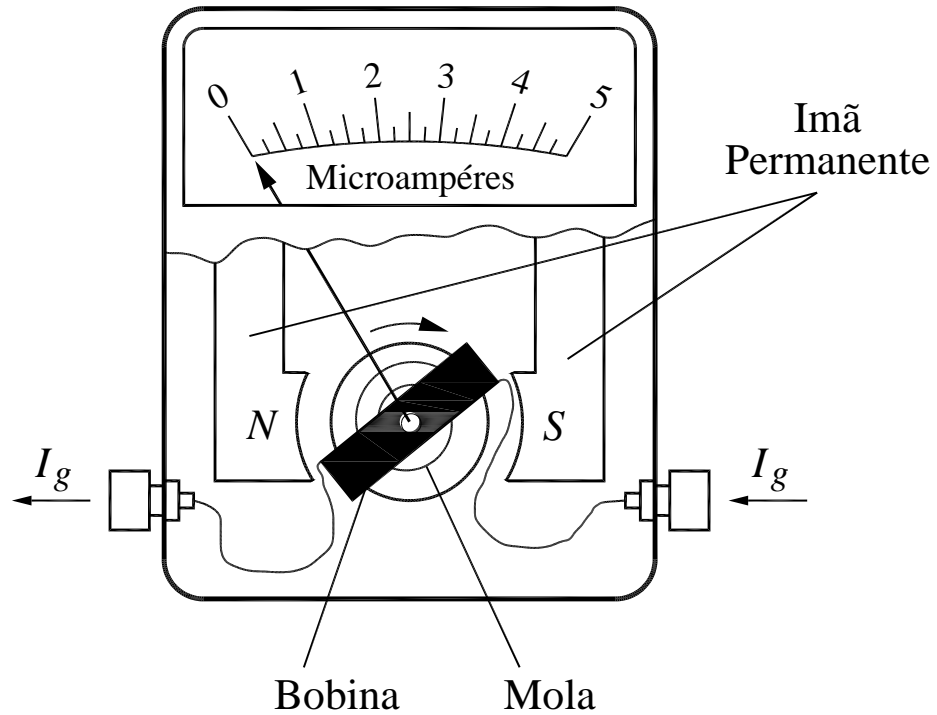


Galvanômetro



$$\tau = CnBI_G$$

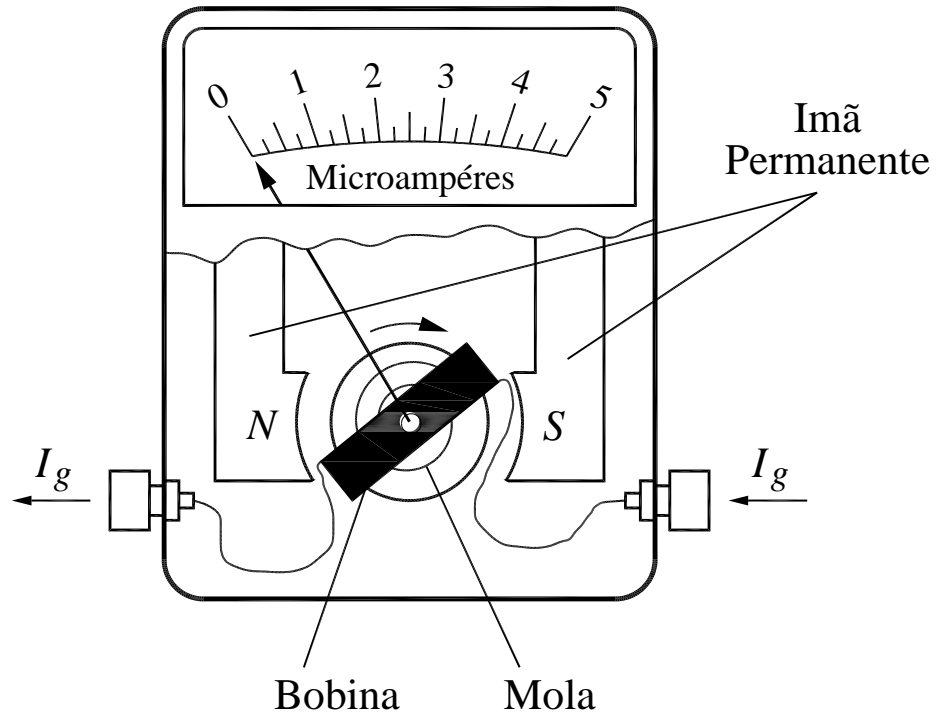
Galvanômetro



$$\tau = CnBI_G$$

$$K\theta = CnBI_G$$

Galvanômetro

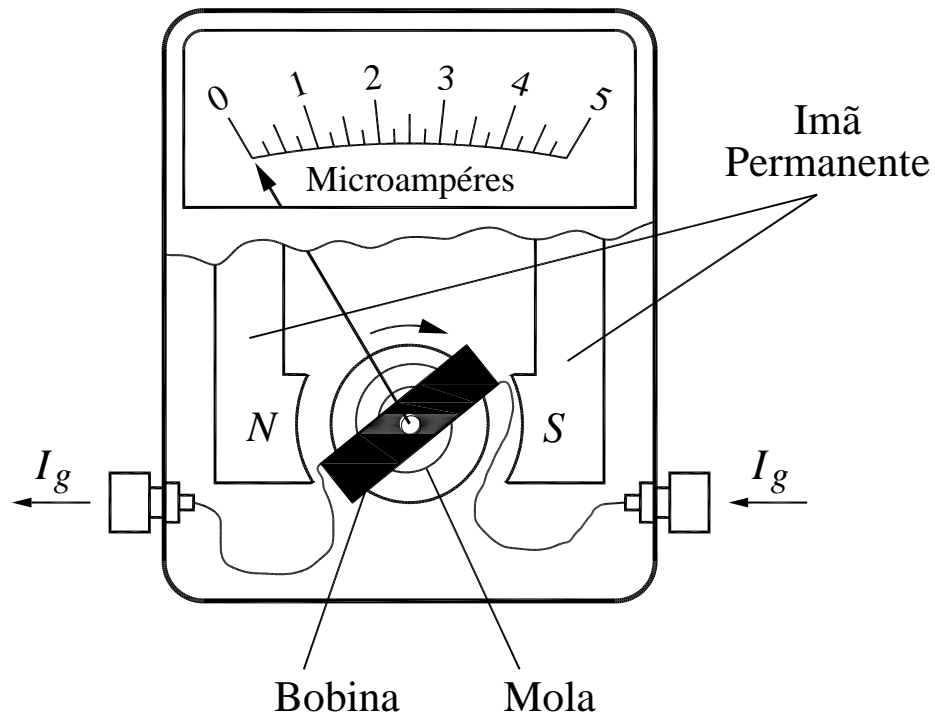


$$\tau = CnBI_G$$

$$K\theta = CnBI_G$$

$$\theta = \frac{CnB}{K} I_G$$

Galvanômetro



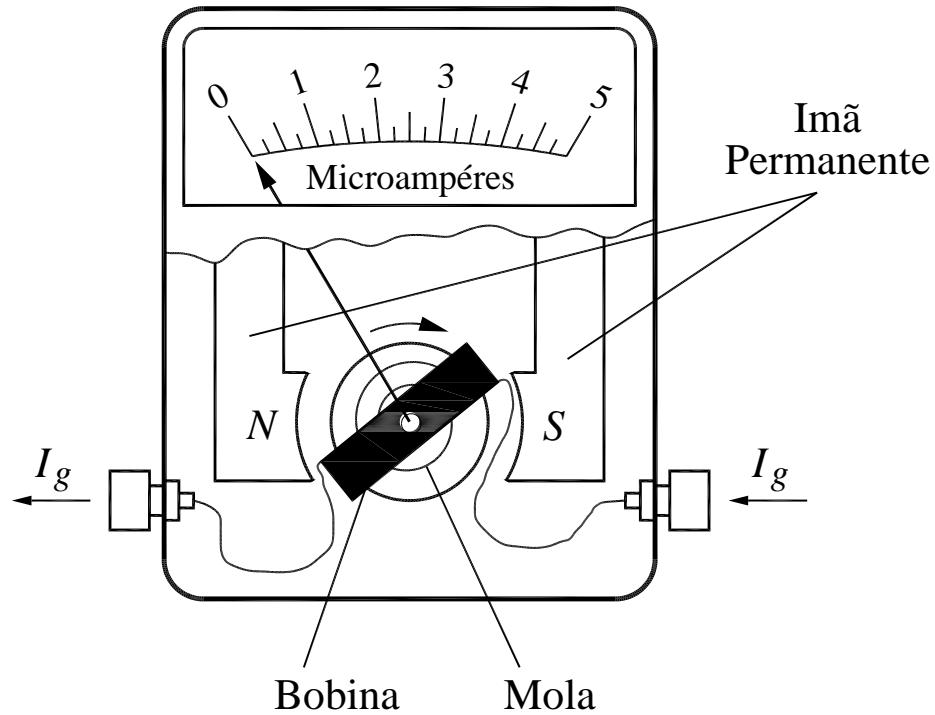
$R_G \rightarrow$ resistência interna

$$\tau = CnBI_G$$

$$K\theta = CnBI_G$$

$$\theta = \frac{CnB}{K} I_G$$

Galvanômetro



$R_G \rightarrow$ resistência interna

$$\tau = CnBI_G$$

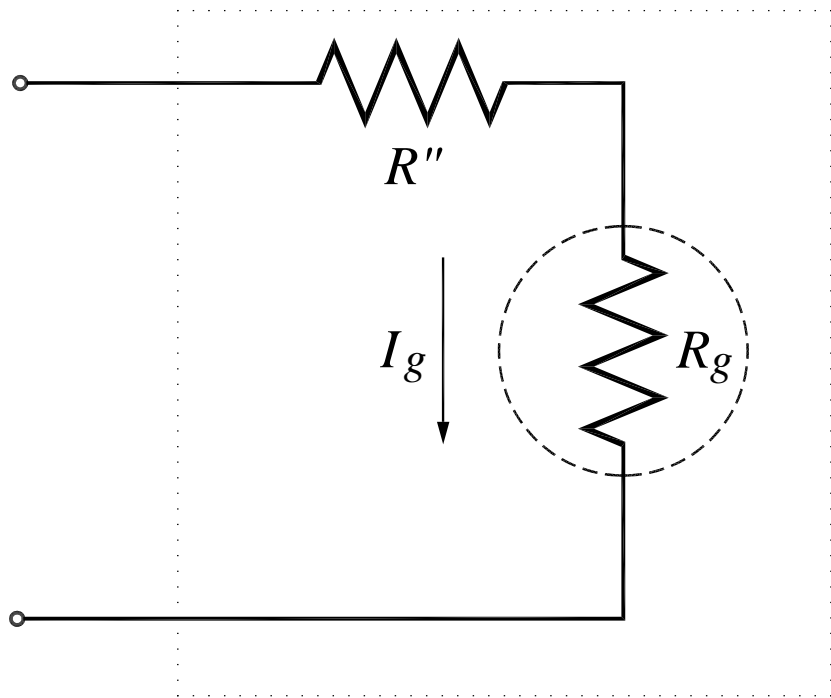
$$K\theta = CnBI_G$$

$$\theta = \frac{CnB}{K} I_G$$

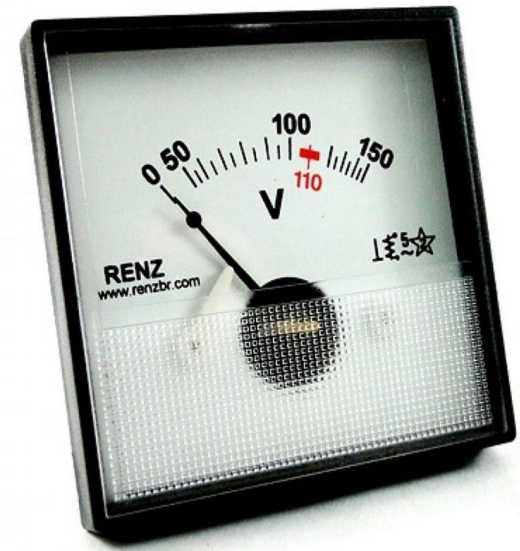
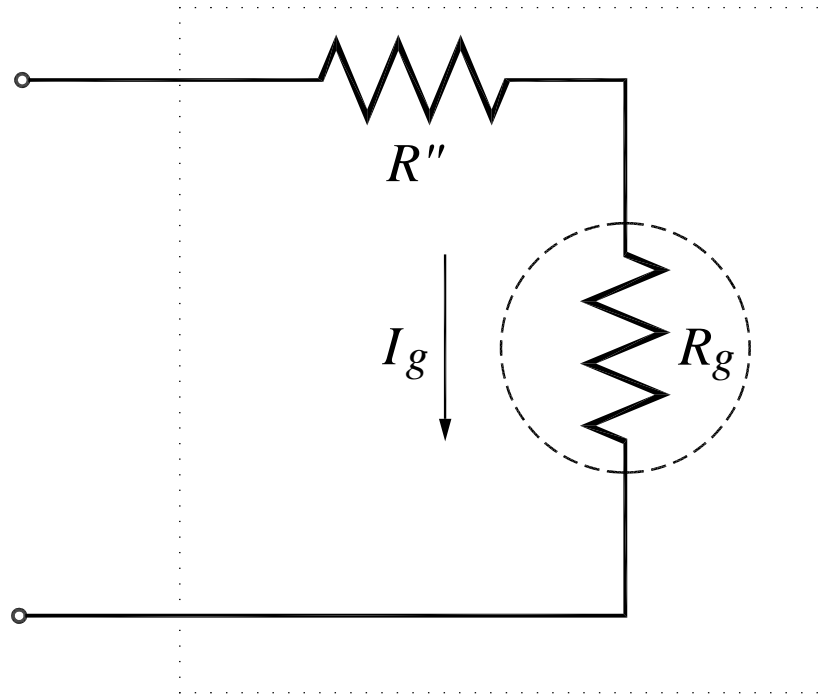
$$V_G = I_G R_G$$

Tensão do fundo de escala \rightarrow na deflexão máxima

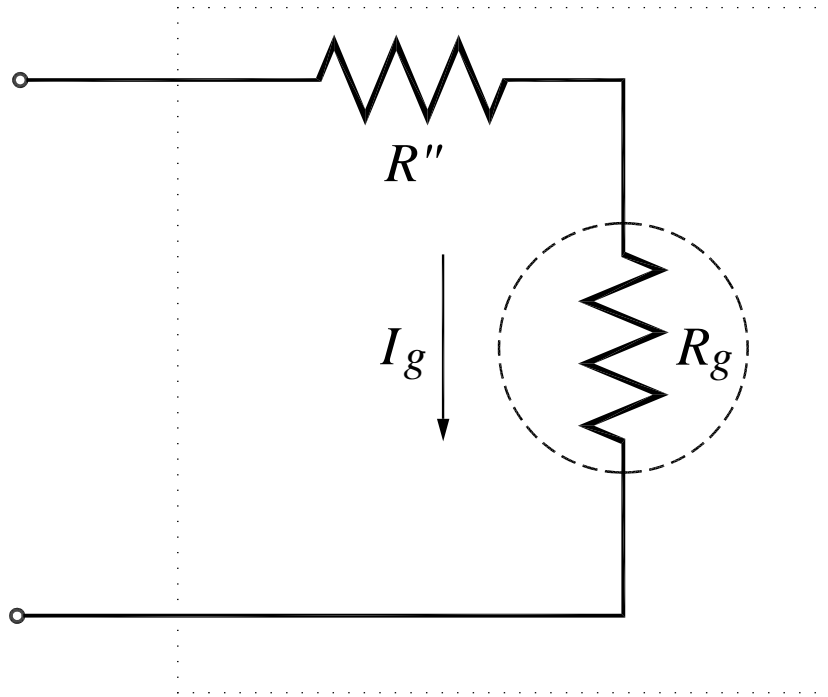
Voltímetro



Voltímetro

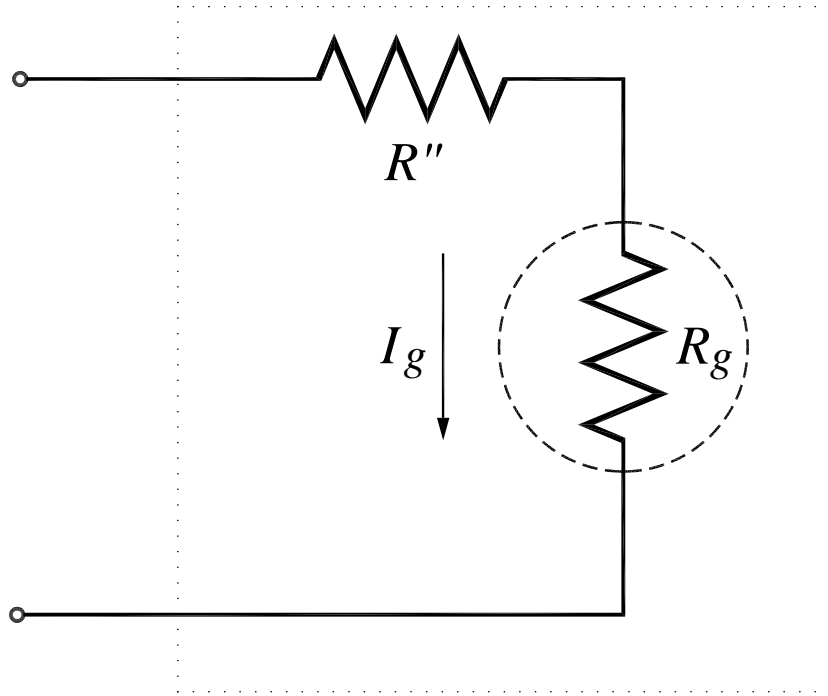


Voltímetro



$$V = (R'' + R_G) I_G \rightarrow I_G = \frac{V}{R'' + R_G}$$

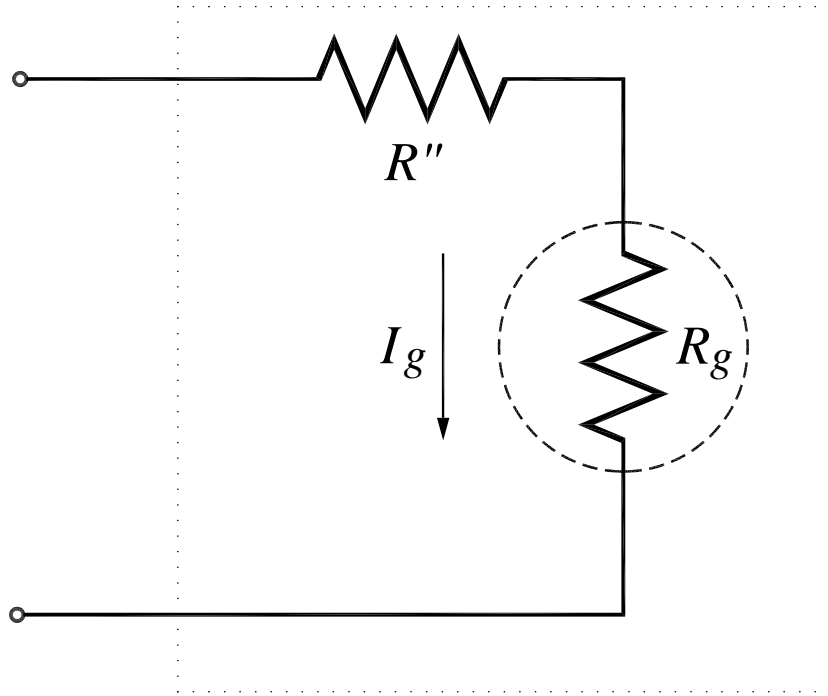
Voltímetro



$$V = (R'' + R_G) I_G \rightarrow I_G = \frac{V}{R'' + R_G}$$

$$V_{\max} = (R'' + R_G) I_{G\max}$$

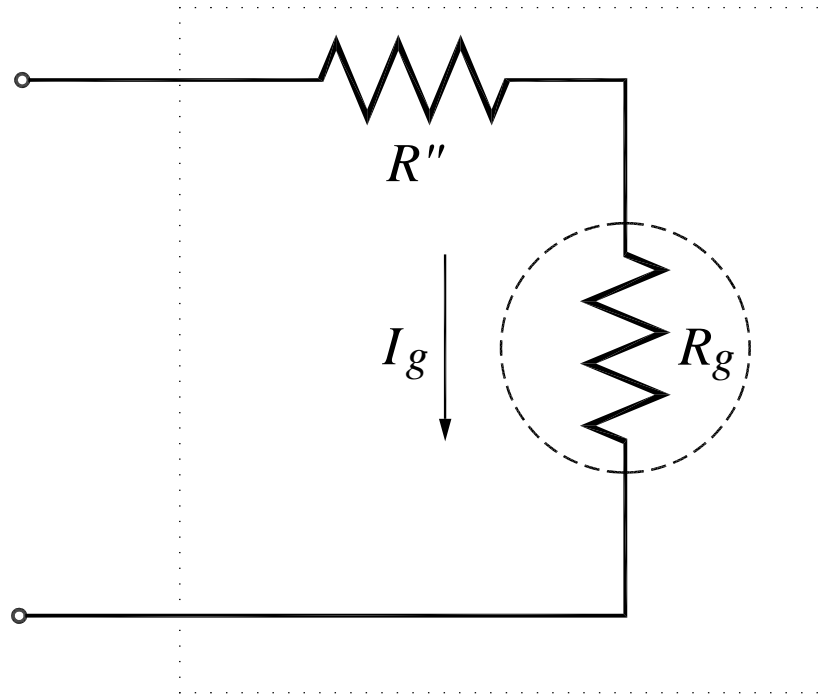
Voltímetro



$$V = (R'' + R_G) I_G \rightarrow I_G = \frac{V}{R'' + R_G}$$

$$V_{\max} = (R'' + R_G) I_{G\max}$$

Voltímetro

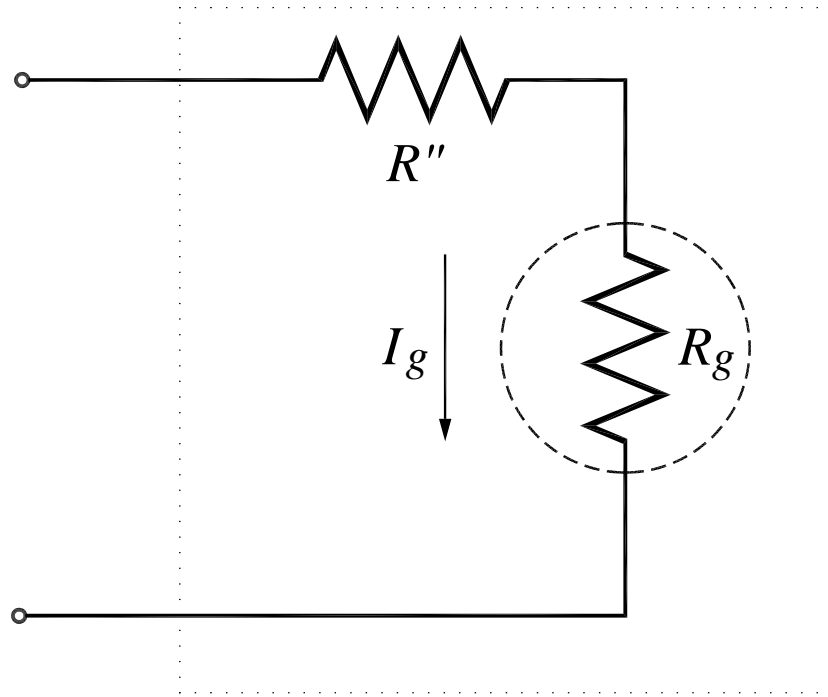


$$V = (R'' + R_G) I_G \rightarrow I_G = \frac{V}{R'' + R_G}$$

$$V_{\max} = (R'' + R_G) I_{G \max}$$

$$R'' = \frac{V_{\max}}{I_{G \max}} - R_G$$

Voltímetro



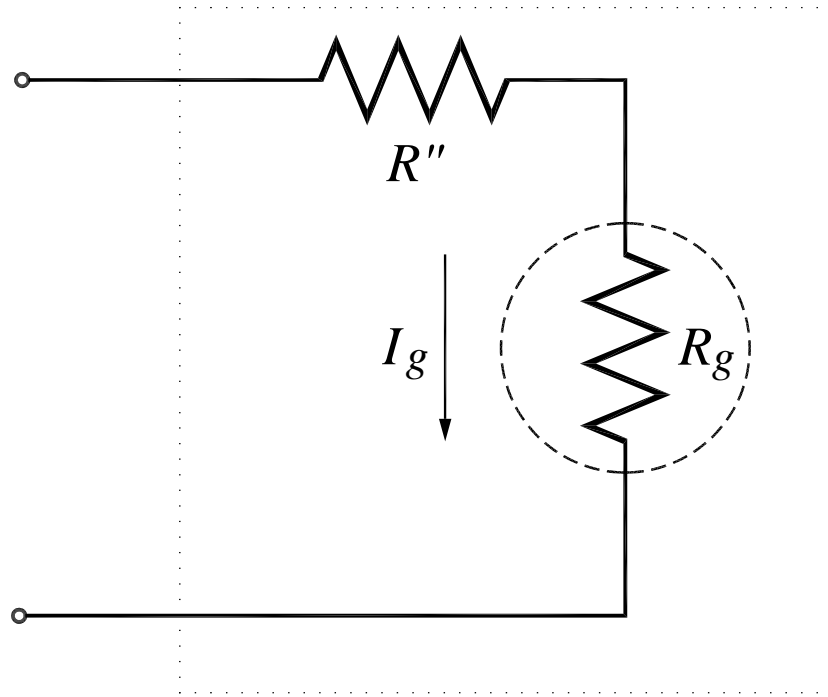
$$V = (R'' + R_G) I_G \rightarrow I_G = \frac{V}{R'' + R_G}$$

$$V_{\max} = (R'' + R_G) I_{G \max}$$

$$R'' = \frac{V_{\max}}{I_{G \max}} - R_G$$

Resistência Interna do Voltímetro: $R_v = R'' + R_G$

Voltímetro



Resistência Interna do Voltímetro: $R_v = R'' + R_G$

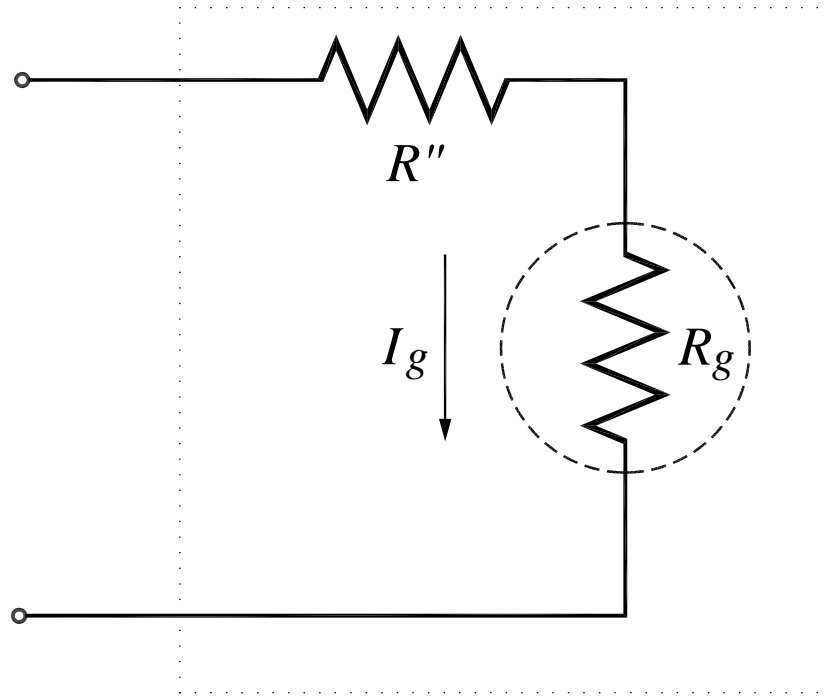
$$V = (R'' + R_G) I_G \rightarrow I_G = \frac{V}{R'' + R_G}$$

$$V_{\max} = (R'' + R_G) I_{G\max}$$

$$R'' = \frac{V_{\max}}{I_{G\max}} - R_G$$

$$R_v = R'' + R_G = \frac{V_{\max}}{I_{G\max}}$$

Voltímetro



Resistência Interna do Voltímetro: $R_v = R'' + R_G$

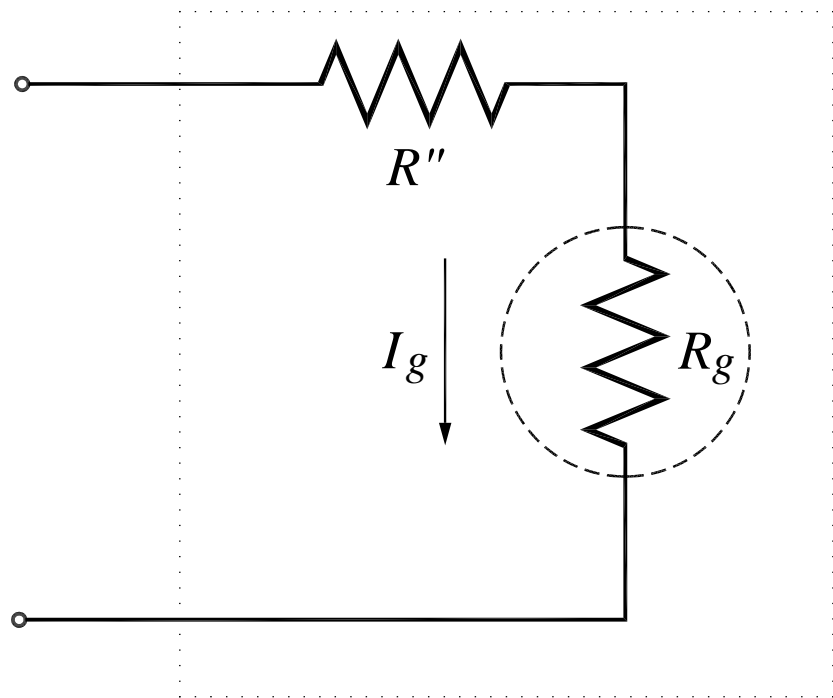
$$V = (R'' + R_G) I_G \rightarrow I_G = \frac{V}{R'' + R_G}$$

$$V_{\max} = (R'' + R_G) I_{G\max}$$

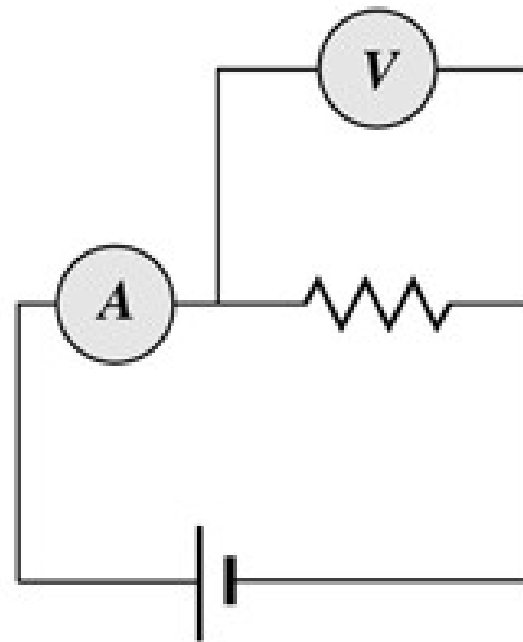
$$R'' = \frac{V_{\max}}{I_{G\max}} - R_G$$

$$R_v = R'' + R_G = \frac{V_{\max}}{I_{G\max}}$$

Voltímetro

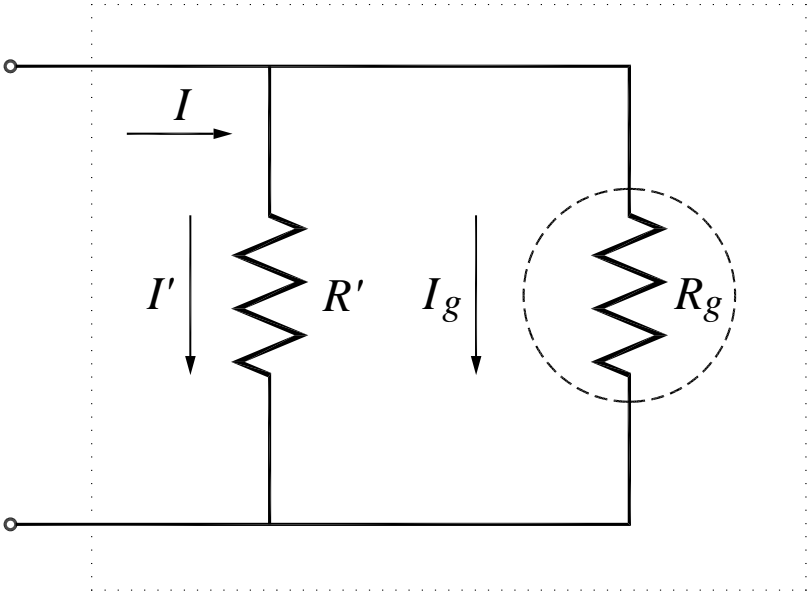


$$R_v = R'' + R_g$$

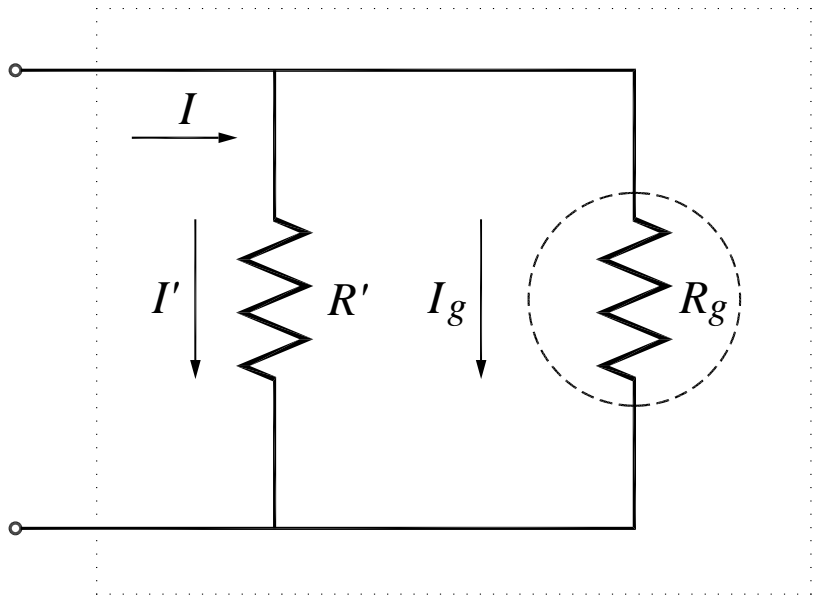


$$i = \frac{\varepsilon}{R} + \frac{\varepsilon}{R_v}$$

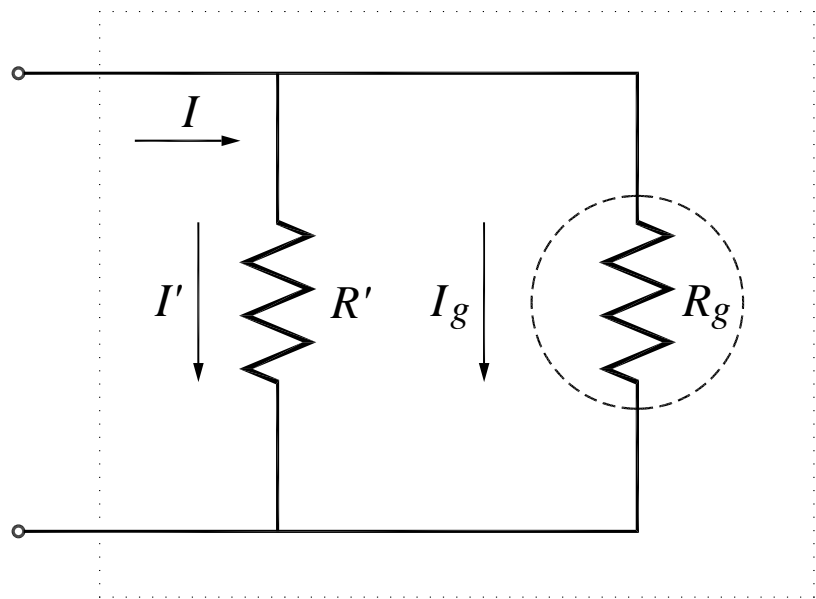
Amperímetros



Amperímetros

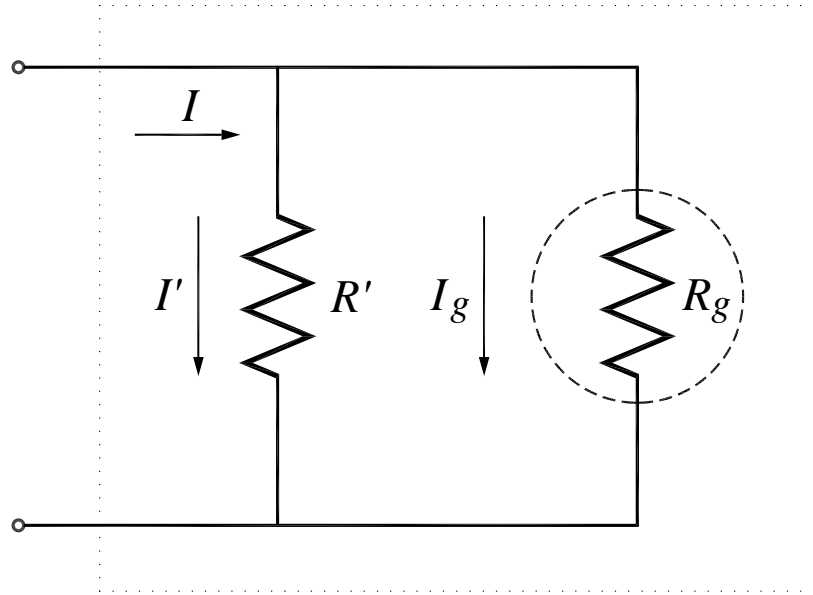


Amperímetros



$$I = I_G + I'$$

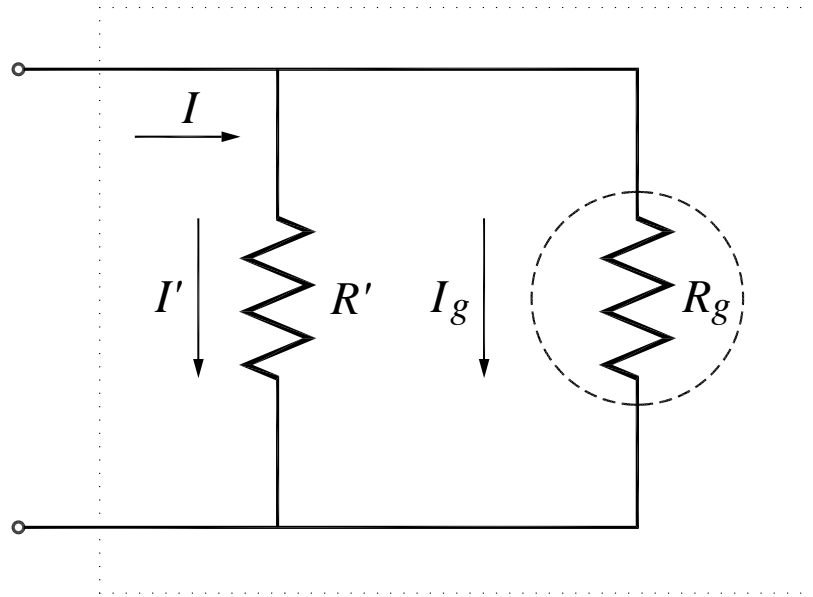
Amperímetros



$$I = I_G + I'$$

$$R' I' = R_G I_G$$

Amperímetros

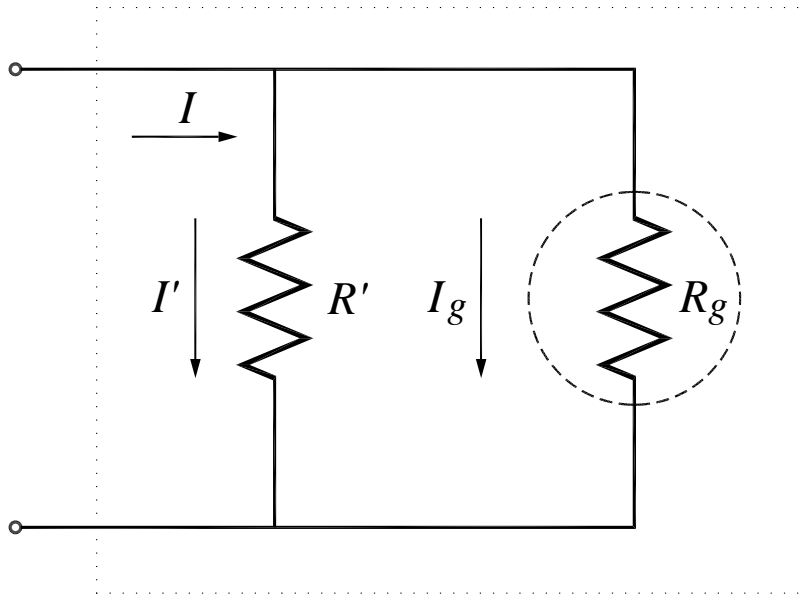


$$I = I_G + I'$$

$$R' I' = R_G I_G$$

$$I_G = \frac{R'}{R' + R_G} I$$

Amperímetros



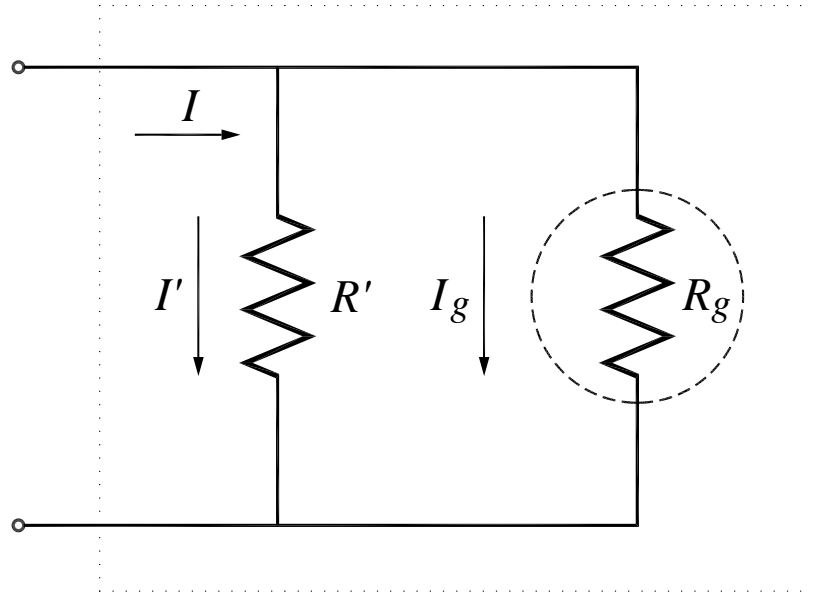
$$I = I_G + I'$$

$$R' I' = R_G I_G$$

Fator de escala

$$I_G = \frac{R'}{R' + R_G} I$$

Amperímetros



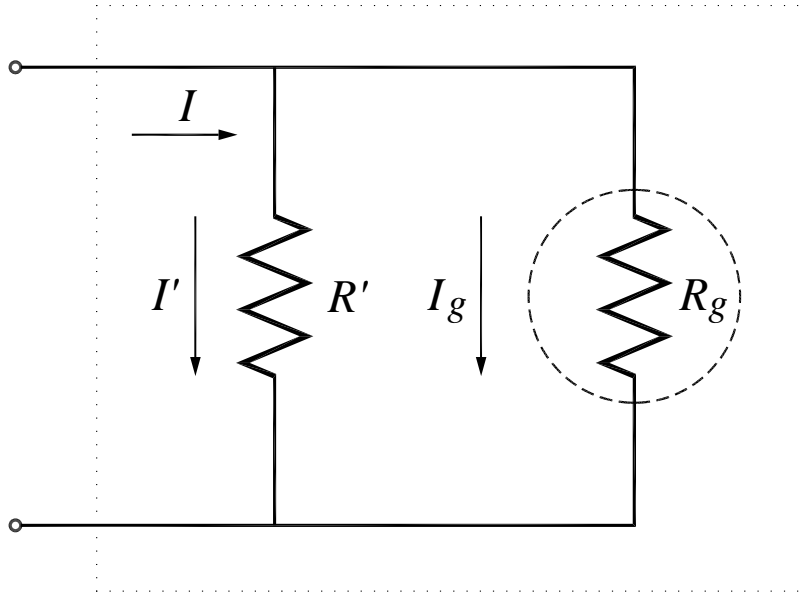
$$I = I_G + I'$$

$$R' I' = R_G I_G$$

$$I_G = \frac{R'}{R' + R_G} I$$

$$I_{\max} = \frac{R' + R_G}{R'} I_{G \max}$$

Amperímetros



$$R' = R_G \frac{I_{G \max}}{I_{\max} - I_{G \max}}$$

$$I = I_G + I'$$

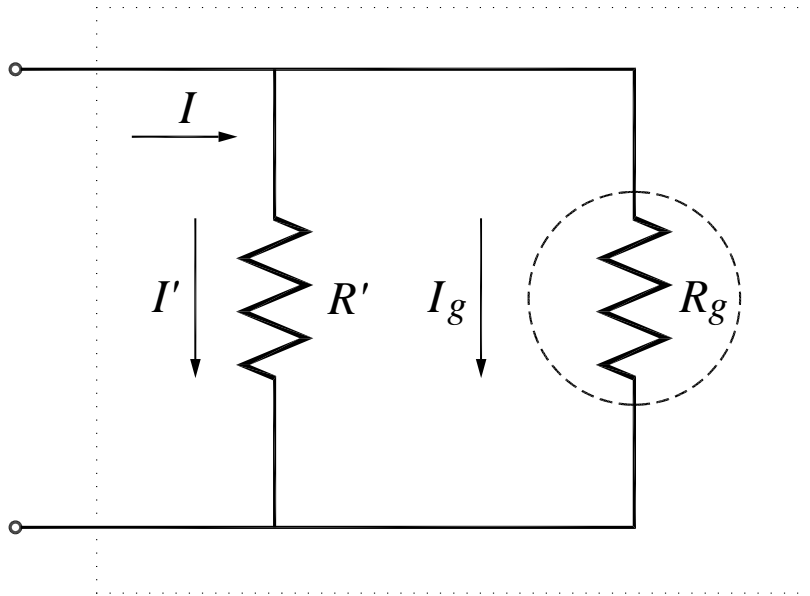
$$R' I' = R_G I_G$$

$$I_G = \frac{R'}{R' + R_G} I$$

$$I_{\max} = \frac{R' + R_G}{R'} I_{G \max}$$

A Resistência do Amp. para medirmos até I max.

Amperímetros



$$R' = R_G \frac{I_{G\max}}{I_{\max} - I_{G\max}}$$

$$I = I_G + I'$$

$$R' I' = R_G I_G$$

$$I_G = \frac{R'}{R' + R_G} I$$

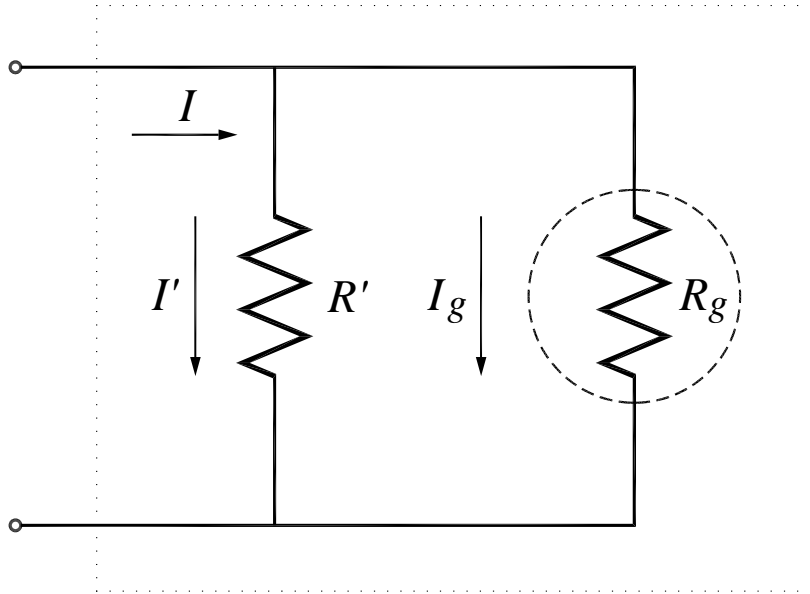
$$I_{\max} = \frac{R' + R_G}{R'} I_{G\max}$$

A Resistência do Amp. para medirmos até I max.

Resistência Interna é:

$$R_a = \frac{R' R_G}{R' + R_G} = \frac{R_G I_{G\max}}{I_{\max}}$$

Amperímetros



$$R' = R_G \frac{I_{G\max}}{I_{\max} - I_{G\max}}$$

$$I = I_G + I'$$

$$R' I' = R_G I_G$$

$$I_G = \frac{R'}{R' + R_G} I$$

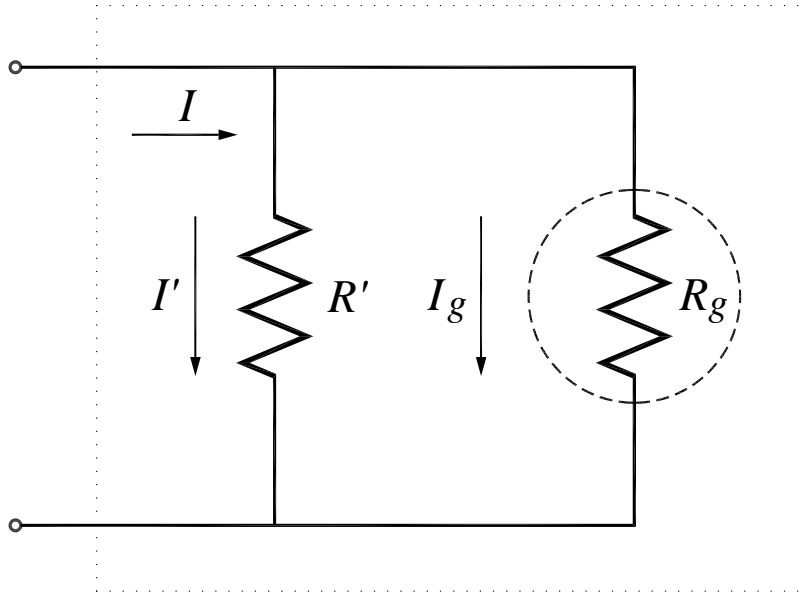
$$I_{\max} = \frac{R' + R_G}{R'} I_{G\max}$$

A Resistência do Amp. para medirmos até I max.

Resistência Interna é:

$$R_a = \frac{R' R_G}{R' + R_G} = \frac{R_G I_{G\max}}{I_{\max}} \quad \text{V do galvanômetro}$$

Amperímetros



$$R' = R_G \frac{I_{G\max}}{I_{\max} - I_{G\max}}$$

$$I = I_G + I'$$

$$R' I' = R_G I_G$$

$$I_G = \frac{R'}{R' + R_G} I$$

$$I_{\max} = \frac{R' + R_G}{R'} I_{G\max}$$

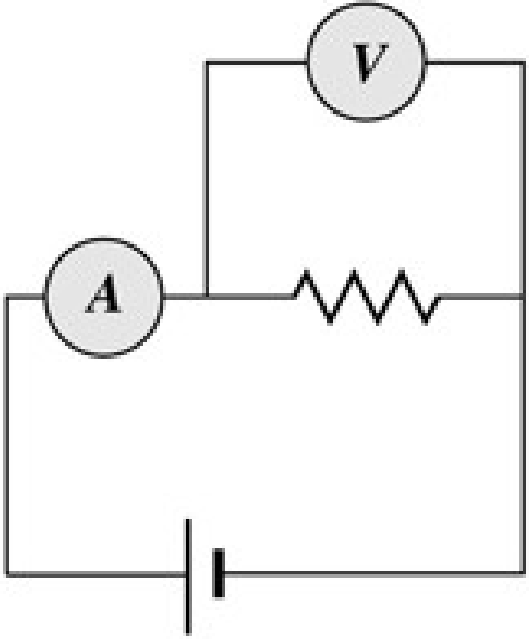
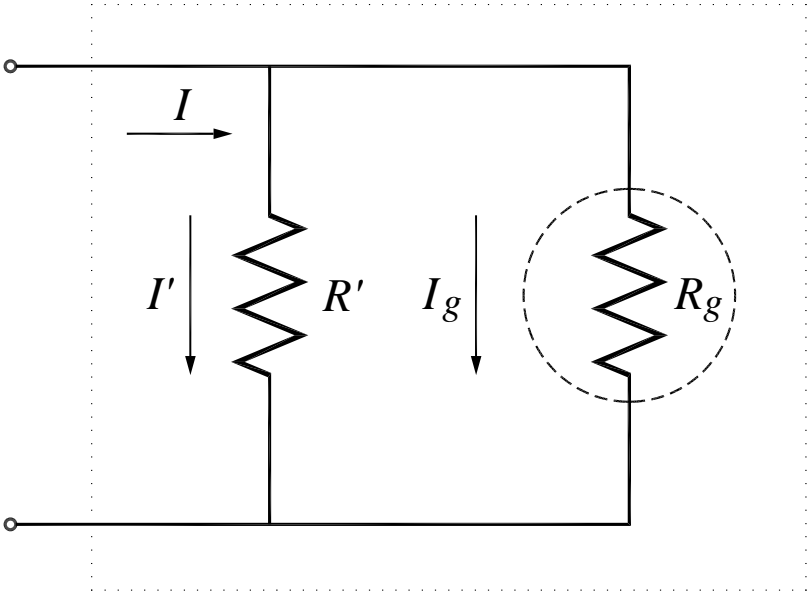
A Resistência do Amp. para medirmos até I max.

Resistência Interna é:

$$R_a = \frac{R' R_G}{R' + R_G} = \frac{R_G I_{G\max}}{I_{\max}}$$

$$R_a = \frac{V_{G\max}}{I_{\max}}$$

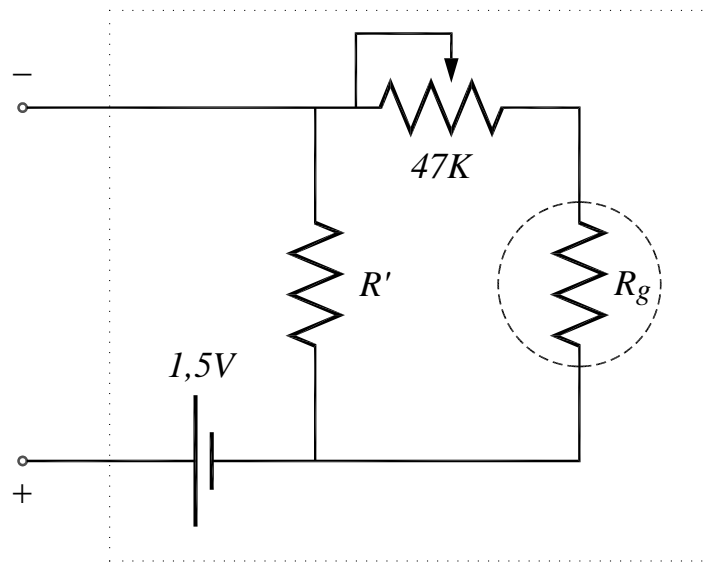
Amperímetros



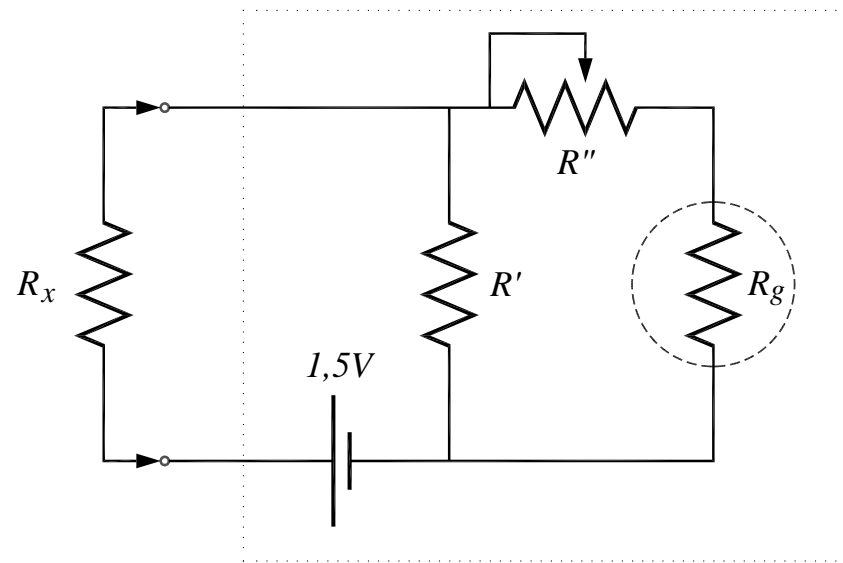
$$R_a \ll R \quad i = \frac{\varepsilon}{R + R_a}$$

Ohmímetro

(a)

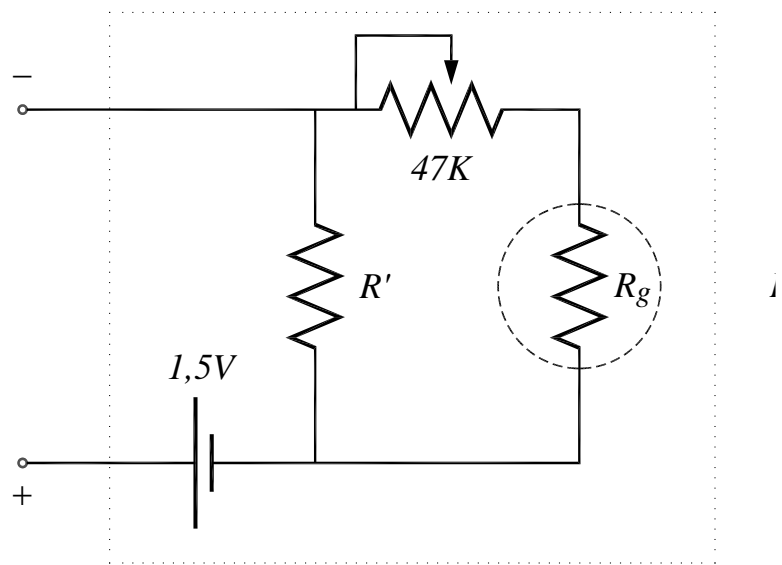


(b)



Ohmímetro

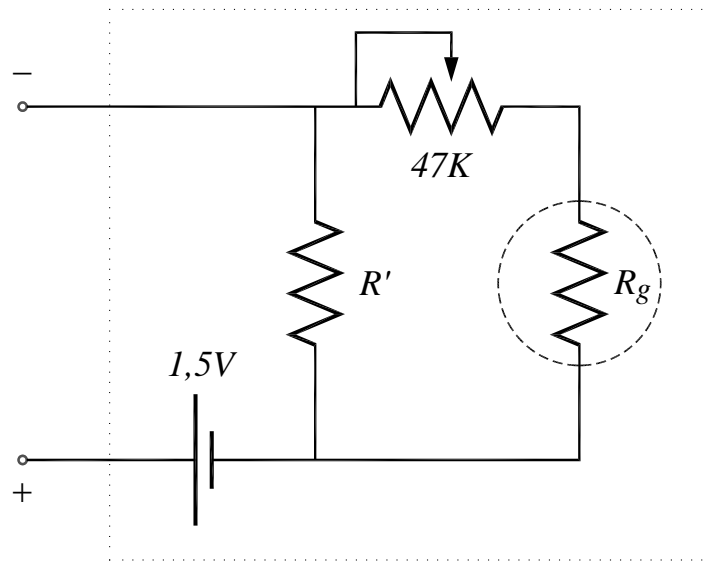
(a)



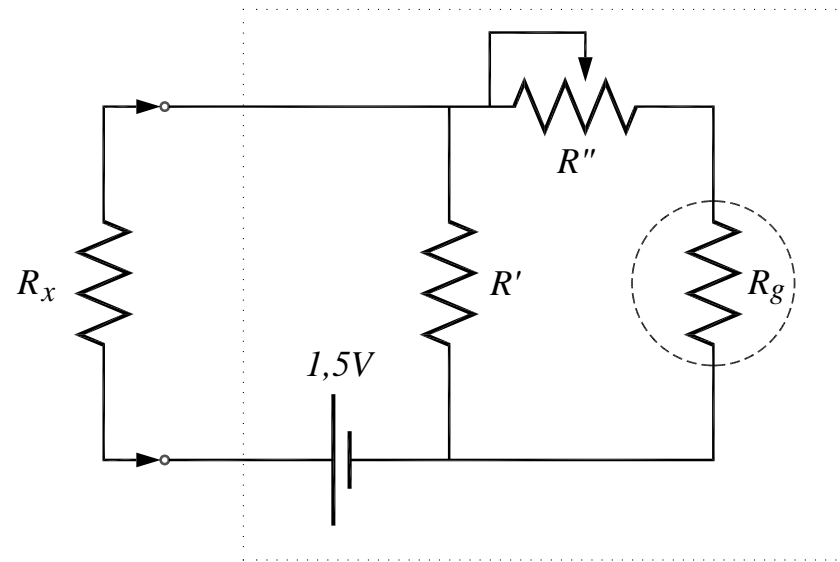
Calibrar:

Ohmímetro

(a)



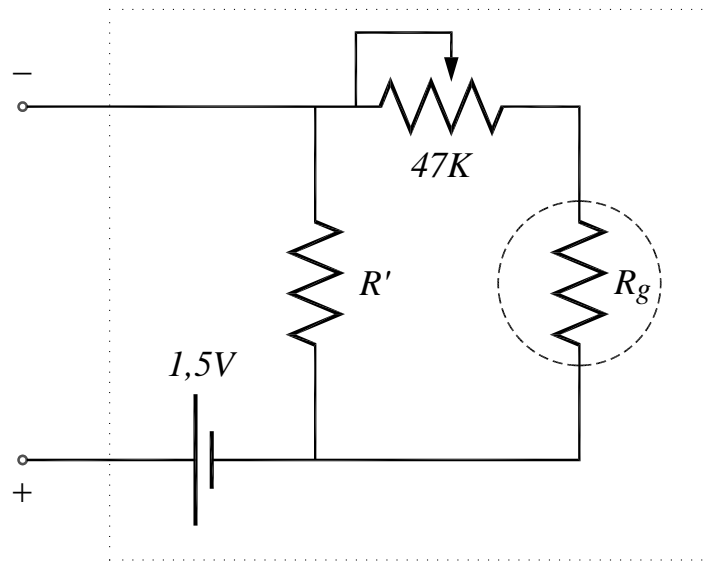
(b)



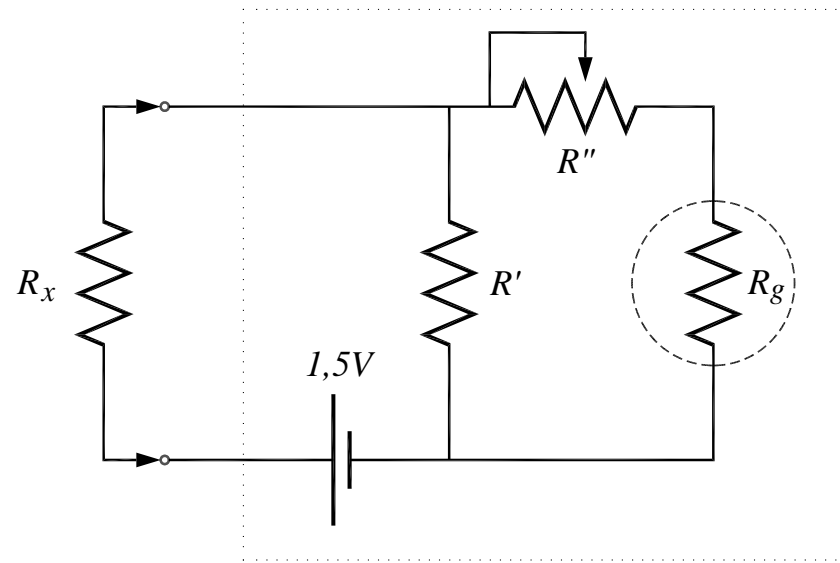
Calibrar:

Ohmímetro

(a)



(b)



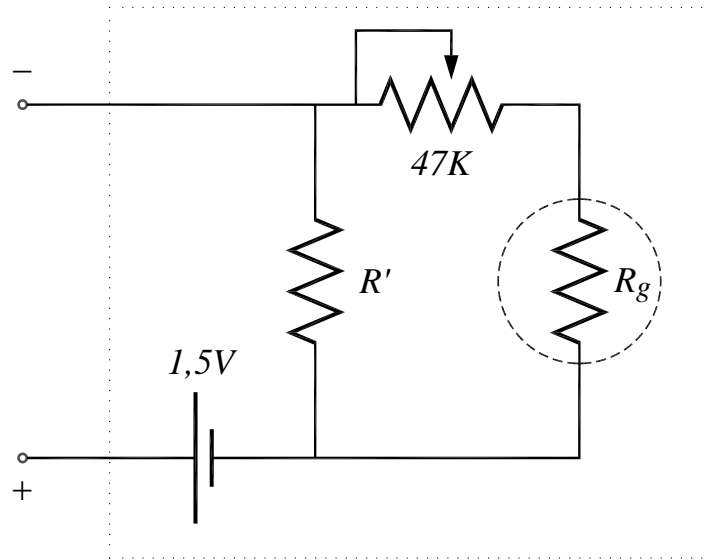
$$R_x I_x + (R'' + R_G) I_G = V_B$$

$$(R'' + R_G) I_G = R' (I_x - I_G)$$

Calibrar:

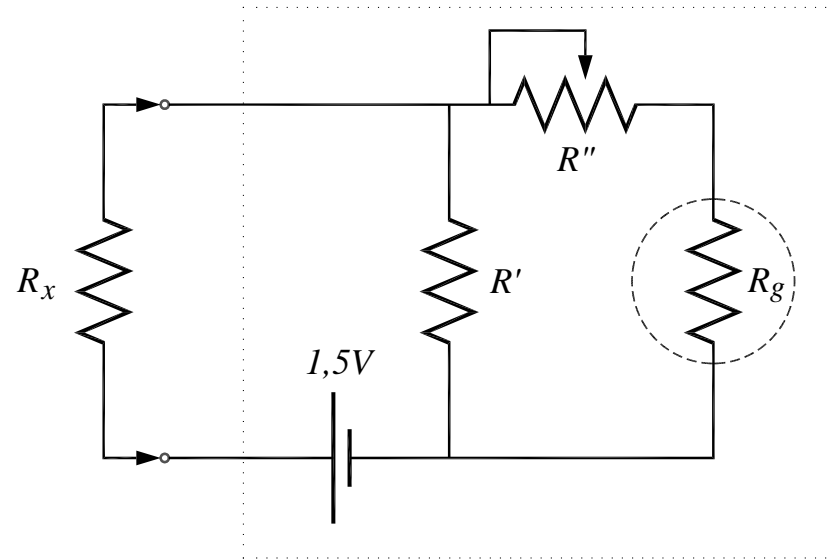
Ohmímetro

(a)



Calibrar:

(b)



$$R_x I_x + (R'' + R_G) I_G = V_B$$

$$(R'' + R_G) I_G = R' (I_x - I_G)$$

$$I_{G\text{máx}} = \frac{V_B}{R_G + R''}, \text{ para } R_x = 0$$

$$I_{G\text{min}} = 0, \text{ para } R_x = \infty$$

Vamos praticar?

Vamos praticar?

Quaaaaaase!!