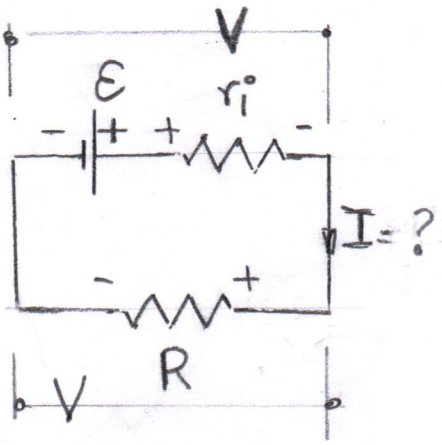
15.2



$\Delta V = V$

$\mathcal{E} = ?$

$R = 5{,}6\ \Omega$

$r_i = 0{,}2\ \Omega$

$V = 10\ V$

$$I = \frac{\mathcal{E}}{R + r_i}$$

$$V = \mathcal{E} = I(R + r_i)$$

$$V = \Delta V = R \cdot I \longrightarrow I = \frac{V}{R} = \frac{10}{5{,}6} = 1{,}79\,(A)$$

$$\mathcal{E} = I(R + r_i) = 1{,}79(5{,}6 + 0{,}2) = 10{,}36\,(V)$$

$$\begin{cases} V = \mathcal{E} - I r_i \\ V = I R \end{cases}$$

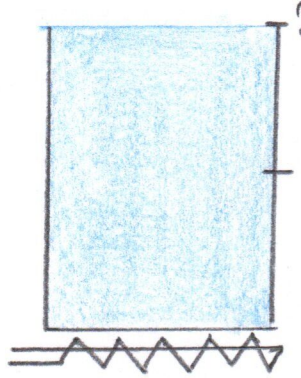
$$\begin{cases} \mathcal{E} - r_i I = V \\ R I = V \end{cases}$$

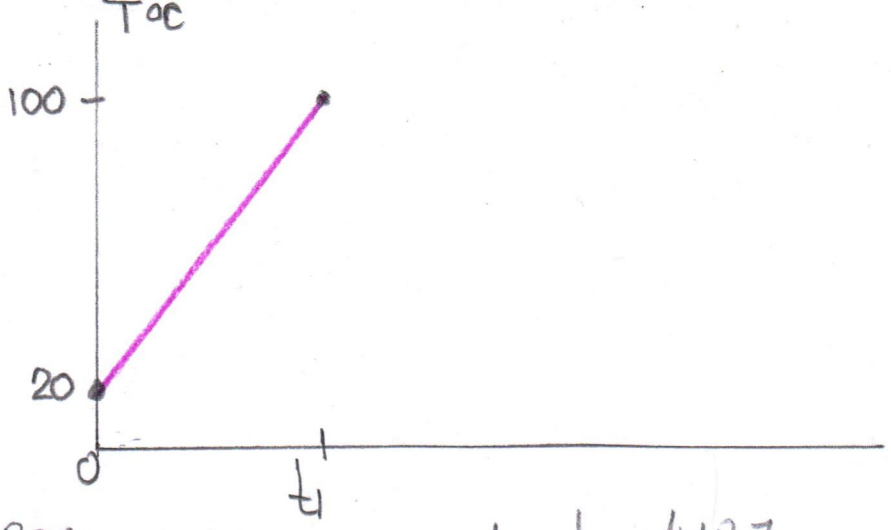
$\mathcal{E} = 10{,}36\ (V)$

$I = 1{,}79\ (A)$

1	−0,2	10
0	5,6	10
1	0	10,36
0	1	1,79

16_6





$P = 500\ W$ Rendimiento 80%

$P' = 400\ W$

1 cal = 4,18 J

1 J = 0,239 cal

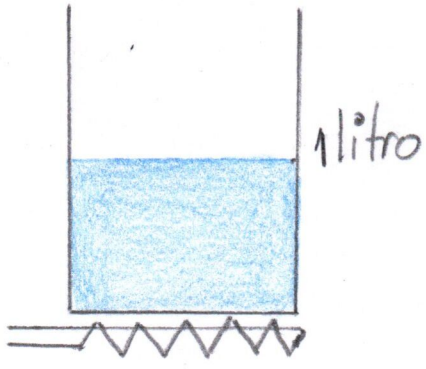
$$P' \cdot t_1 = m_{H_2O} \cdot Ce \cdot (Tf - Ti) = 2000 \cdot 1 \cdot (100-20) =$$

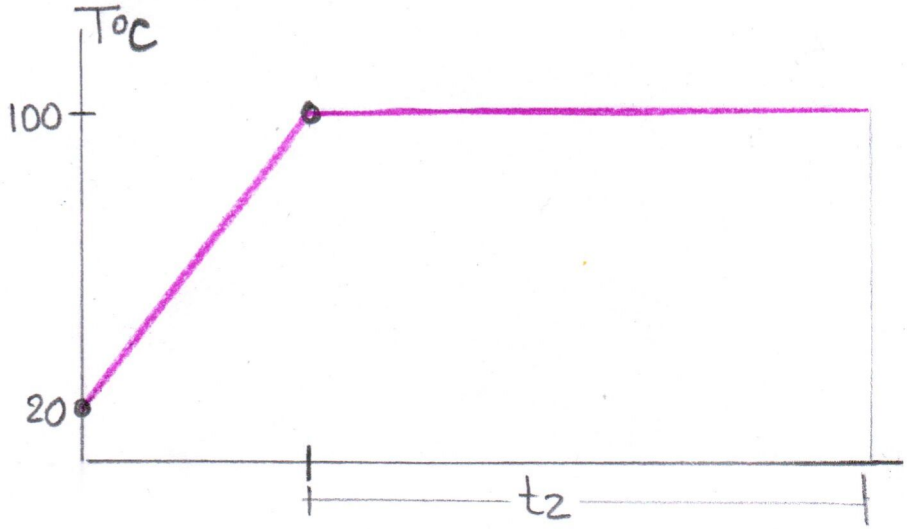
$$= 160.000\,(cal) = 668800\,(J)$$

$$t_1 = \frac{m_{H_2O}\, Ce\, (Tf - Ti)}{P'} = \frac{668800\,(J)}{400\,(W)} = 1672\,(s)$$

$$= 27,87\,(min)$$

t_1 = es el tiempo que demora en calentar a 100° los 2 litros de H_2O.





$$L_V = 2255\ \ 10^3 \left(\frac{J}{Kg}\right) = 2255 \left(\frac{J}{g}\right)$$

$$P' \cdot t_2 = m_{H_2O} \cdot L_v$$

$$t_2 = \frac{m_{H_2O} \cdot L_v}{P'} = \frac{1000 \cdot 2255}{400} =$$

$$= 5637{,}5 \text{ (s)}$$

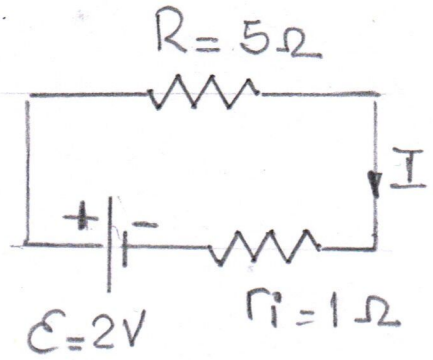
$$= 93{,}96 \text{ min}$$

$$= 1 \text{ h } 34 \text{ min}$$

t_2 = es el tiempo que demora evaporar 1 litro de H_2O.

L_v calor latente = 2255 (J/g)

16.9



$\Delta t = 1\,min = 60\,(s)$

$$I = \frac{\varepsilon}{R + r_i} = \frac{2}{5+1} = \frac{1}{3} = 0,\hat{3}\ (A)$$

$$I.\varepsilon = I^2 R + I^2 r_i$$

$$\frac{1}{3}\cdot 2 = \left(\frac{1}{3}\right)^2 \cdot 5 + \left(\frac{1}{3}\right)^2 \cdot 1$$

$$\frac{2}{3} = \frac{5}{9} + \frac{1}{9}\quad (W)$$

$$0,\hat{6}\,(W) = 0,5\,(W) + 0,\hat{1}\,(W)$$

Pot. generada químicamente = Pot. disipada sobre carga + Pot disipada dentro de la fuente

U generada químicamente = U disipada sobre carga + U disipada dentro de la fuente

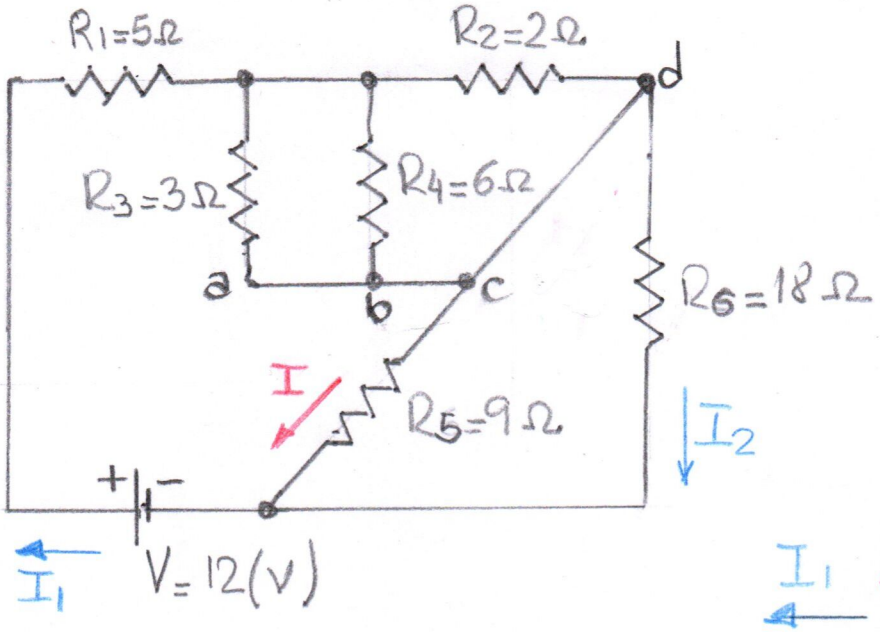
$$I\varepsilon.\Delta t = I^2.R.\Delta t + I^2 r_i.\Delta t$$

$$\frac{2}{3}.60 = \frac{5}{9}.60 + \frac{1}{9}.60$$

$$40\,(J) = 33,\hat{3}\,(J) + 6,\hat{6}\,(J)$$

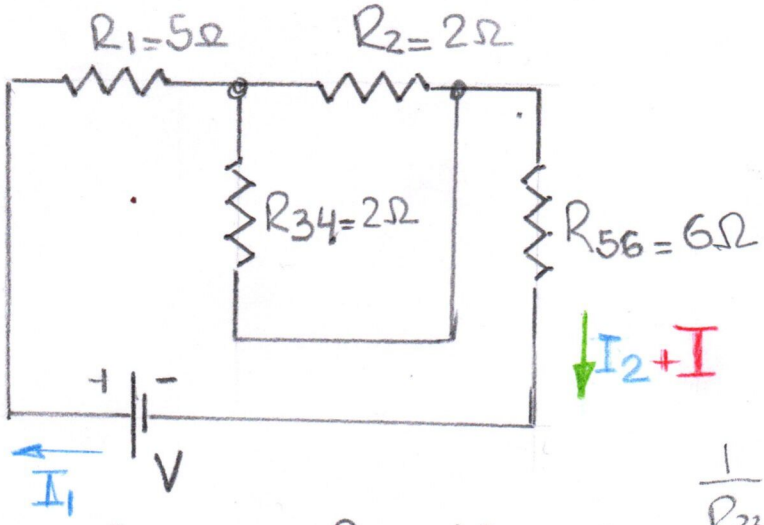
18.5

$\Delta V = V$

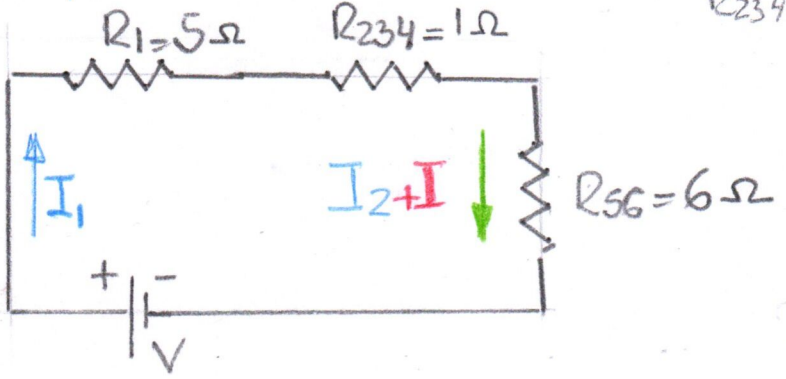


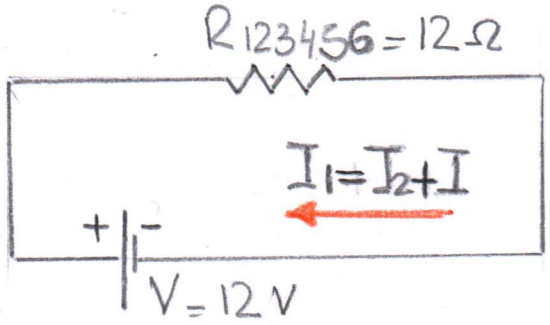
$I_1 - I_2 - I = 0$

$I_1 = I_2 + I$



$\frac{1}{R_{234}}$





$$\frac{1}{R_{34}} = \frac{1}{R_3} + \frac{1}{R_4} = \frac{1}{3} + \frac{1}{6} \longrightarrow R_{34} = 2\,\Omega$$

$$\frac{1}{R_{56}} = \frac{1}{R_5} + \frac{1}{R_6} = \frac{1}{9} + \frac{1}{18} \longrightarrow R_{56} = 6\,\Omega$$

$$V_{56} = V_5 = V_6 = R_{56} \cdot (I_2 + I) = R_{56} \cdot I_1$$

$$R_{123456} = R_1 + R_{234} + R_{56} = 5 + 1 + 6 = 12\,\Omega$$

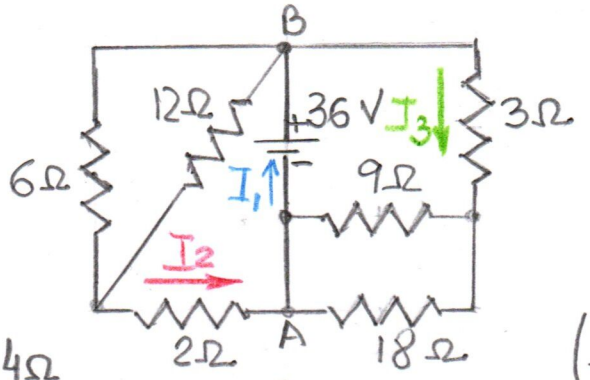
$$I_1 = I_2 + I = \frac{V}{R_{123456}} = \frac{12}{12} = 1\,(A)$$

$$V_{56} = 6 \cdot 1 = 6\,(V)$$

$$I = \frac{V_5}{R_5} = \frac{6}{9} = \frac{2}{3} = 0,\overline{6}\,(A)$$

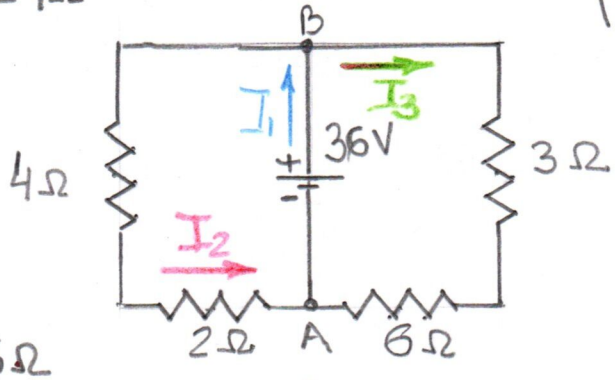
$$I_2 = \frac{V_6}{R_6} = \frac{6}{18} = \frac{1}{3} = 0,\overline{3}\,(A)$$

18.6



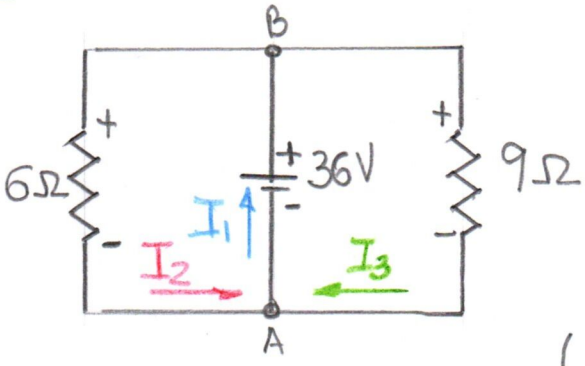
$\left(\frac{1}{6\Omega}+\frac{1}{12\Omega}\right)^{-1}=4\Omega$

$\left(\frac{1}{9\Omega}+\frac{1}{18\Omega}\right)^{-1}=6\,\Omega$



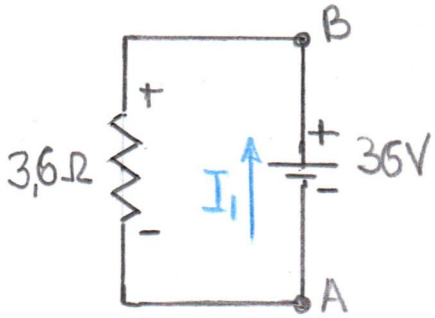
$4\Omega+2\Omega=6\Omega$

$6\Omega+3\Omega=9\Omega$



$I_1=I_2+I_3$

$\left(\frac{1}{6\Omega}+\frac{1}{9\Omega}\right)^{-1}=3{,}6\,\Omega$

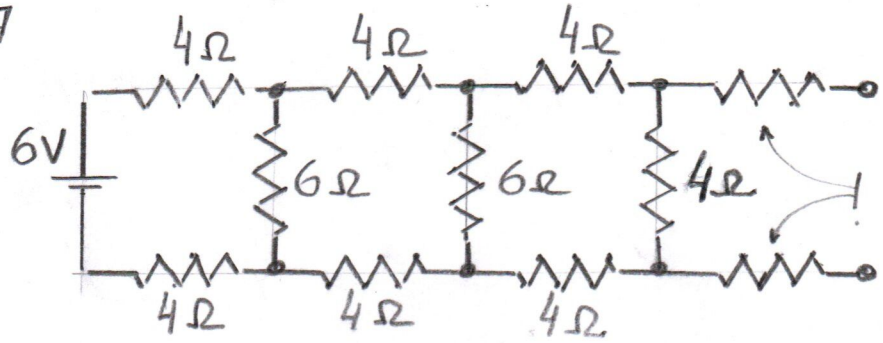


$I_1=\frac{36\,V}{3{,}6\,\Omega}=10\,A$

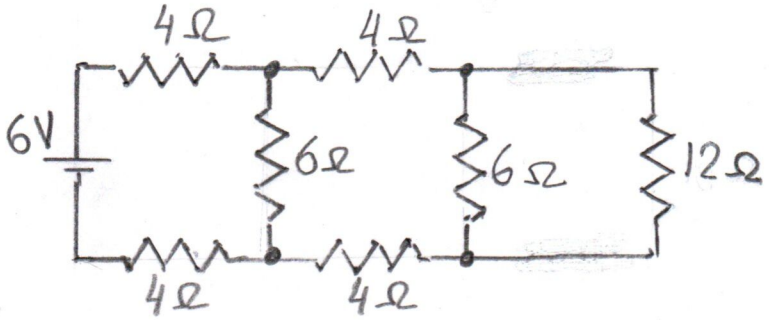
$I_2=\frac{36\,V}{6}=6\,A$

$I_3=\frac{36V}{9}=4\,A$

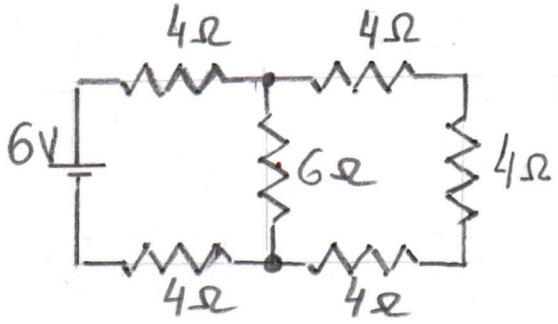
18.7



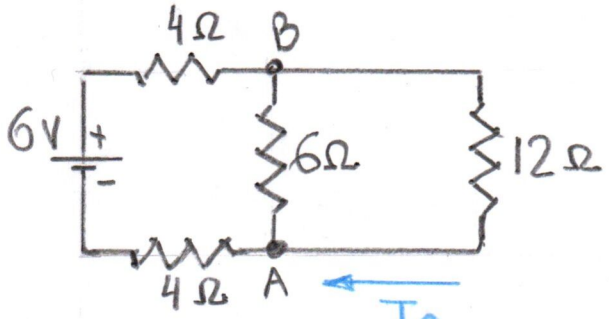
se eliminan visto que están a circuito abierto



$4+4+4 = 12\,\Omega$

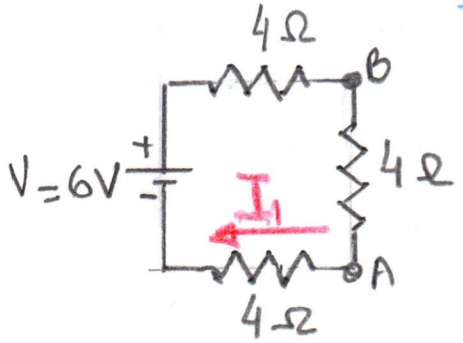


$\left(\frac{1}{6}+\frac{1}{12}\right)^{-1} = 4\,\Omega$



$4+4+4 = 12\,\Omega$

$\left(\frac{1}{6}+\frac{1}{12}\right)^{-1} = 4\,\Omega$

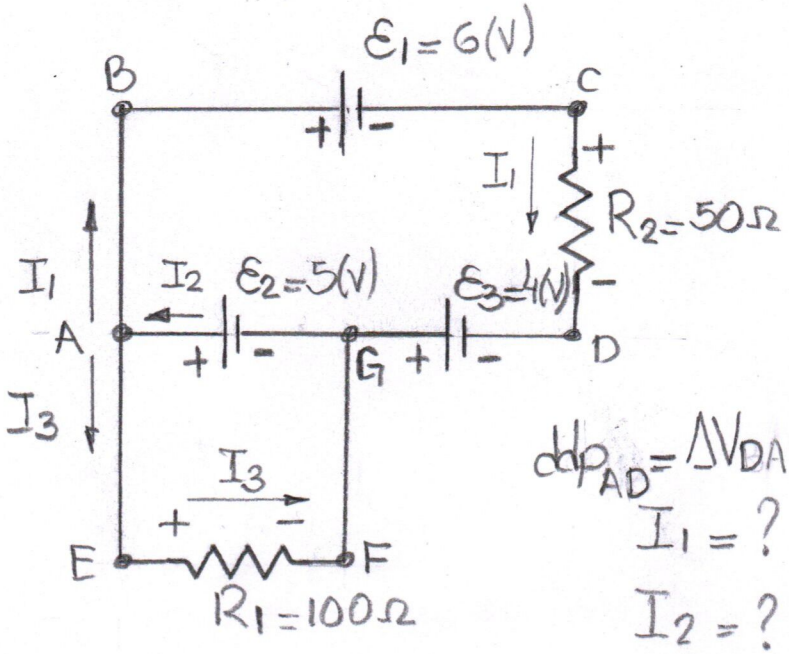


$$I_1 = \frac{6}{12} = 0{,}5\,(A)$$

$$V_{AB} = 4 \cdot I_1 = 4 \cdot 0{,}5 = 2\,(V)$$

$$I_2 = \frac{V_{AB}}{12\,\Omega} = \frac{2(V)}{12} = 0{,}1\hat{6}\,(A)$$

19.1



$ddp_{AD} = \Delta V_{DA} = V_D - V_A = ?$

$I_1 = ?$

$I_2 = ?$

ABCDGA : $-\mathcal{E}_1 - R_2 I_1 + \mathcal{E}_3 + \mathcal{E}_2 = 0$

AGFEA : $-\mathcal{E}_2 + R_1 I_3 = 0$

Nodo A : $I_2 - I_1 - I_3 = 0$

$$I_1 = \frac{\mathcal{E}_2 + \mathcal{E}_3 - \mathcal{E}_1}{R_2} = \frac{5+4-6}{50} = \frac{3}{50} = 0{,}06\,(A)$$

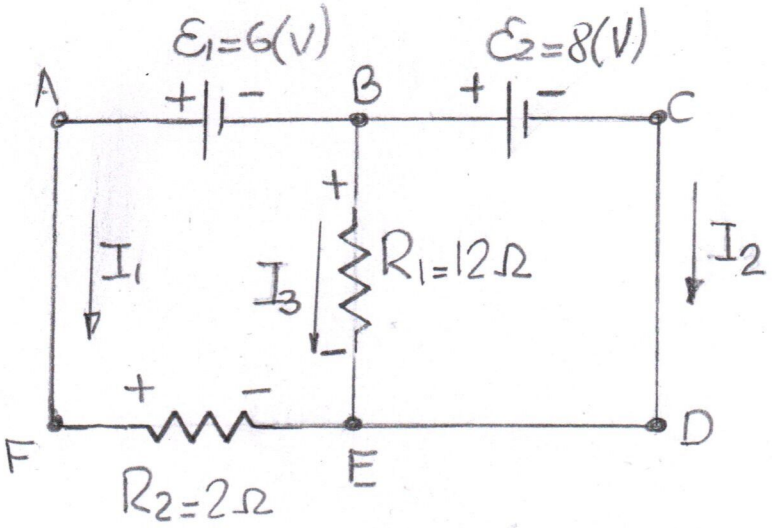
$$I_3 = \frac{\mathcal{E}_2}{R_1} = \frac{5}{100} = 0{,}05\,(A)$$

$$I_2 = I_1 + I_3 = 0{,}06 + 0{,}05 = 0{,}11\,(A)$$

$$V_D = V_A - \mathcal{E}_1 - \mathcal{E}_2 \longrightarrow V_D - V_A = -\mathcal{E}_1 - \mathcal{E}_2 = -5 - 4 = -9\,(V)$$

$V_A > V_D$

19_2



ABEFA: $-\mathcal{E}_1 - R_1 I_3 + R_2 I_1 = 0$

BCDEB: $-\mathcal{E}_2 + R_1 I_3 = 0$

Nodo B: $-I_1 - I_2 - I_3 = 0$

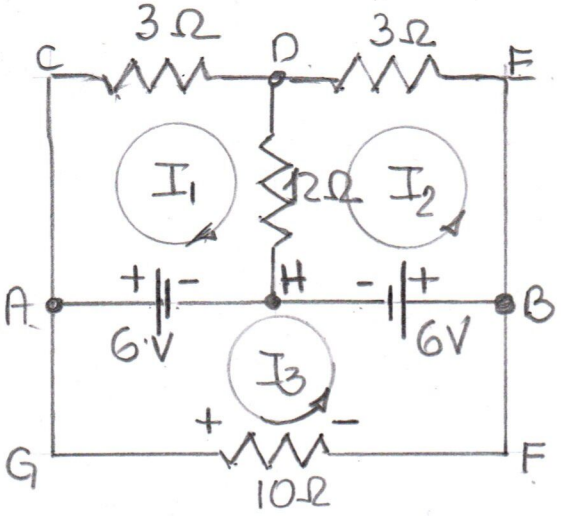
$$\begin{cases} 2I_1 - 12I_3 = 6 \\ 12I_3 = 8 \\ -I_1 - I_2 - I_3 = 0 \end{cases}$$

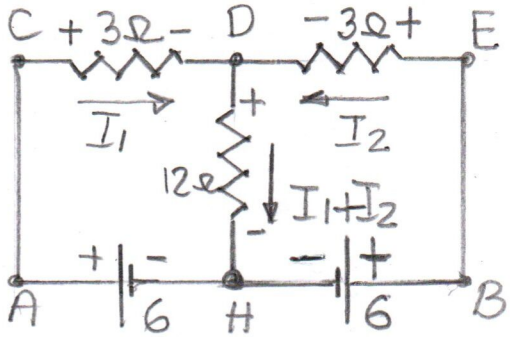
$I_1 = 7\,(A)$

$I_2 = -\frac{23}{3}\,(A)$ — [signo negativo indica sentido de circulación contrario al propuesto

$I_3 = \frac{2}{3}\,(A)$

19.3





AHBFGA : $-6+6+10I_3=0 \longrightarrow I_3=0$

CDHAC : $-3I_1-12(I_1+I_2)+6=0$

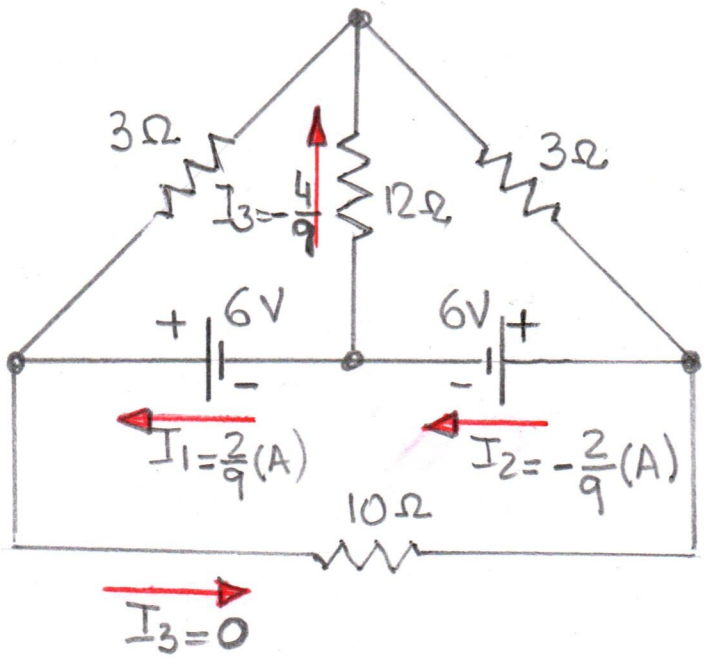
$-3I_1-12I_1-12I_2=-6$

$-15I_1-12I_2=-6$

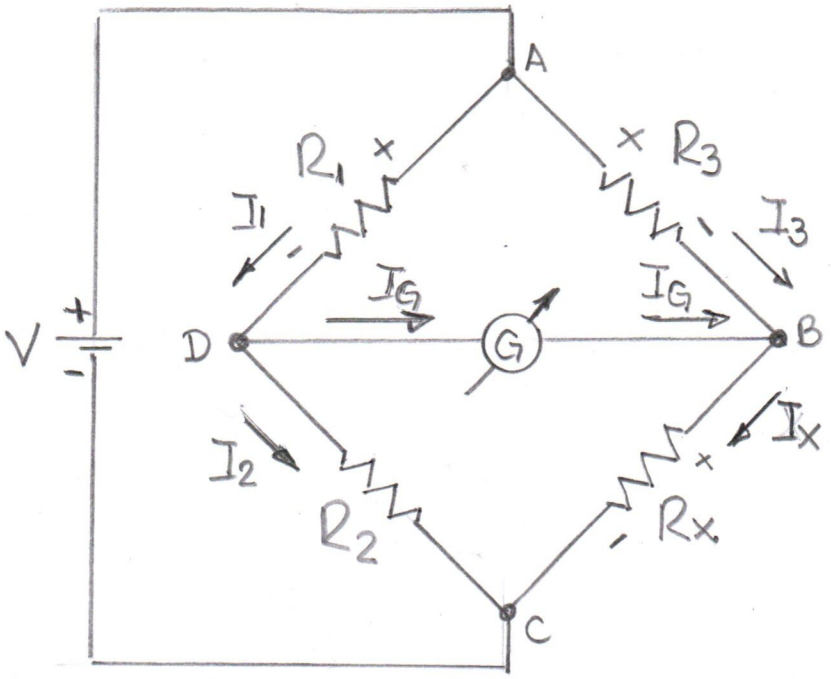
DEBHD : $+3I_2-6+12(I_1+I_2)=0$

$12I_1+15I_2=6$

$$\begin{cases} -15I_1-12I_2=-6 \\ 12I_1+15I_2=6 \end{cases} \qquad \begin{cases} I_1=2/9\ (A) \\ I_2=2/9\ (A) \end{cases}$$



PUENTE DE WHEATSTONE



Nodo D: $I_1 - I_2 - I_G = 0$

Nodo B: $I_3 + I_G - I_x = 0$

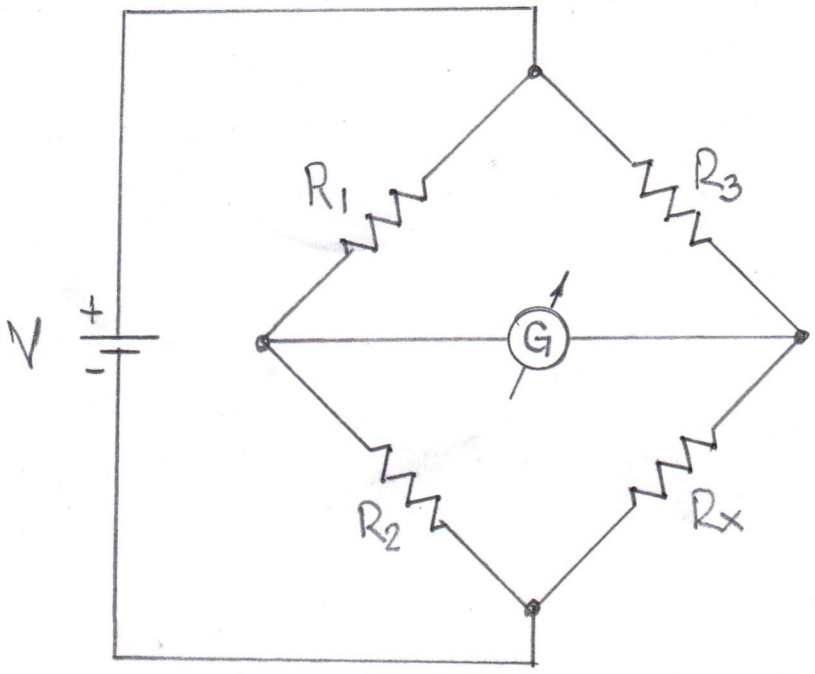
$I_3 \cdot R_3 = I_1 R_1$

$I_x R_x = I_2 R_2$

$$\frac{I_3}{I_1} = \frac{I_x}{I_2} \longrightarrow I_G = 0 \begin{cases} I_3 = I_x \\ I_1 = I_2 \end{cases}$$

$$\frac{R_2}{R_x} = \frac{R_1}{R_3} \qquad R_x = \frac{R_2 \cdot R_3}{R_1}$$

20_1



$R_3 = 1\,K\Omega$

$R_1 = 2.5\,R_2$

$$R_x = \frac{R_2 \cdot R_3}{R_1} = \frac{R_2 \cdot R_3}{2.5 \cdot R_2} =$$

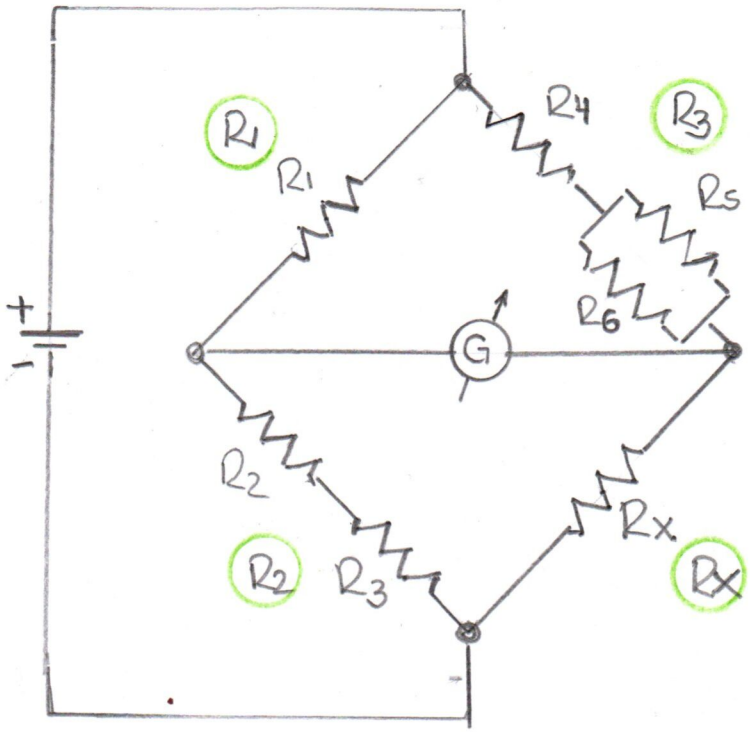
$$= \frac{1000}{2,5} = 400\,(\Omega)$$

20_2 $R_1 = 10\,\Omega$ $R_2 = 20\,\Omega$ $R_3 = 30\,\Omega$

$$R_x = \frac{R_2 \cdot R_3}{R_1} = \frac{20 \cdot 30}{10} =$$

$$= 60\ \Omega$$

20.3



$R_1 = 100\,\Omega$

$R_2 = 50\,\Omega$

$R_3 = 100\,\Omega$

$R_4 = 50\,\Omega$

$R_5 = 200\,\Omega$

$R_6 = 200\,\Omega$

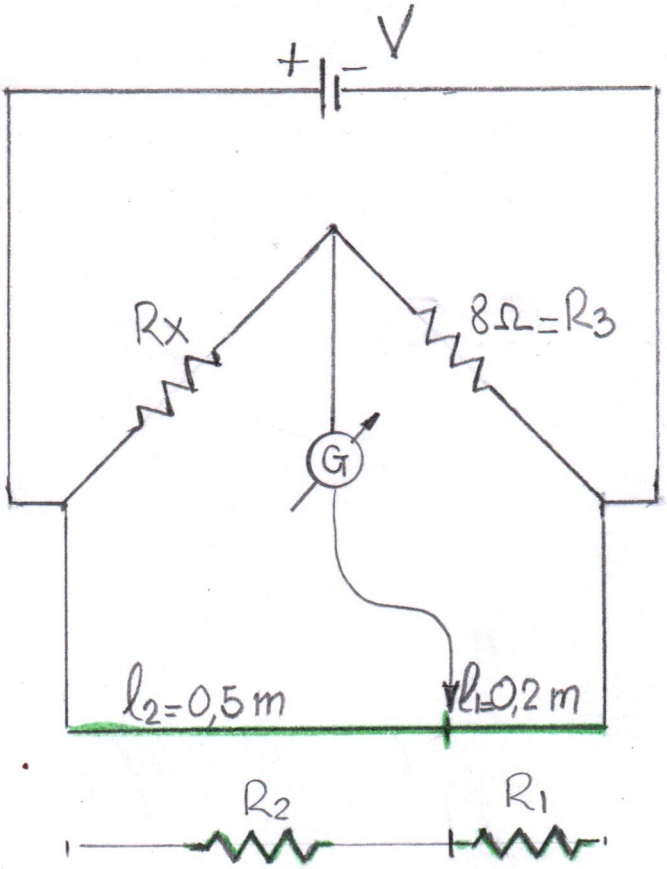
$R_2 = 50\,\Omega + 100\,\Omega = 150\,\Omega$

$R_3 = 50\,\Omega + \left(\frac{1}{200\,\Omega} + \frac{1}{200\,\Omega}\right)^{-1} = 150\,\Omega$

$R_1 = 100\,\Omega$

$$R_x = \frac{R_2 \cdot R_3}{R_1} = \frac{150\,\Omega \cdot 150\,\Omega}{100\,\Omega} = 225\,\Omega$$

20_4

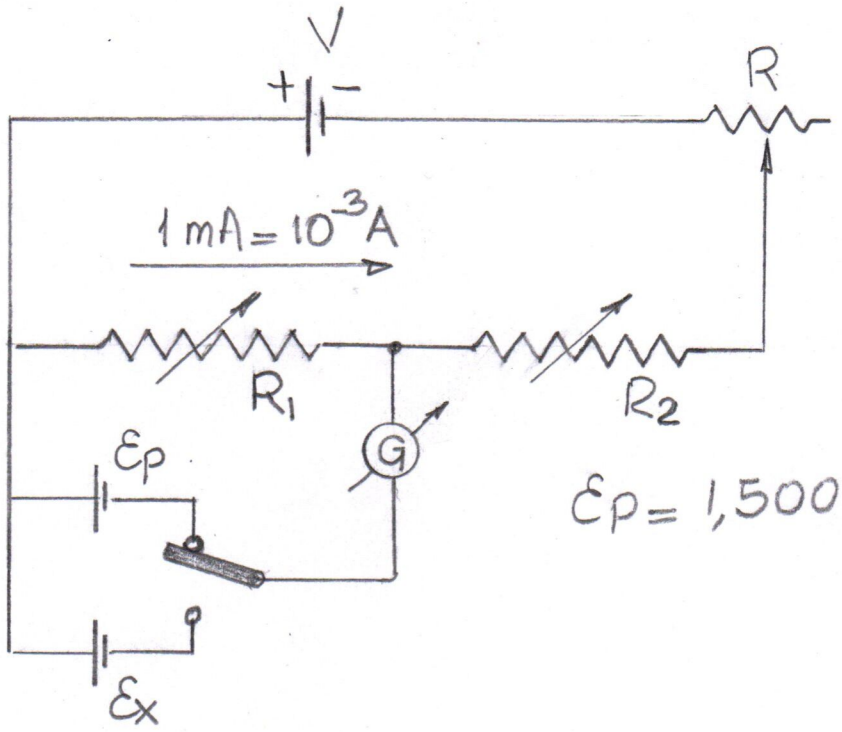


$$R_2 = \frac{\rho\, l_2}{A} \qquad R_1 = \frac{\rho\, l_1}{A}$$

$$R_x = \frac{R_2 \cdot R_3}{R_1} = \frac{\frac{\rho l_2}{A} \cdot R_3}{\frac{\rho l_1}{A}} = \frac{0{,}5(m) \cdot 8(\Omega)}{0{,}2(m)} =$$

$$= 20(\Omega)$$

20.5



$\varepsilon_p = 1{,}500\,(V)$

$R_{12} = R_1 + R_2 = 1500 + 4500 = 6000\,(\Omega)$

$R_1 = 1850\,(\Omega)$

$R_2 = 6000 - 1850 = 4150\,(\Omega)$

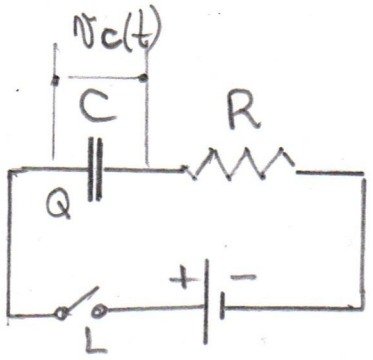
$\varepsilon_x = 1{,}850\,(V)$

R_1 y R_2 se pueden variar en forma individual por ejemplo $0 - 9.999\,(\Omega)$

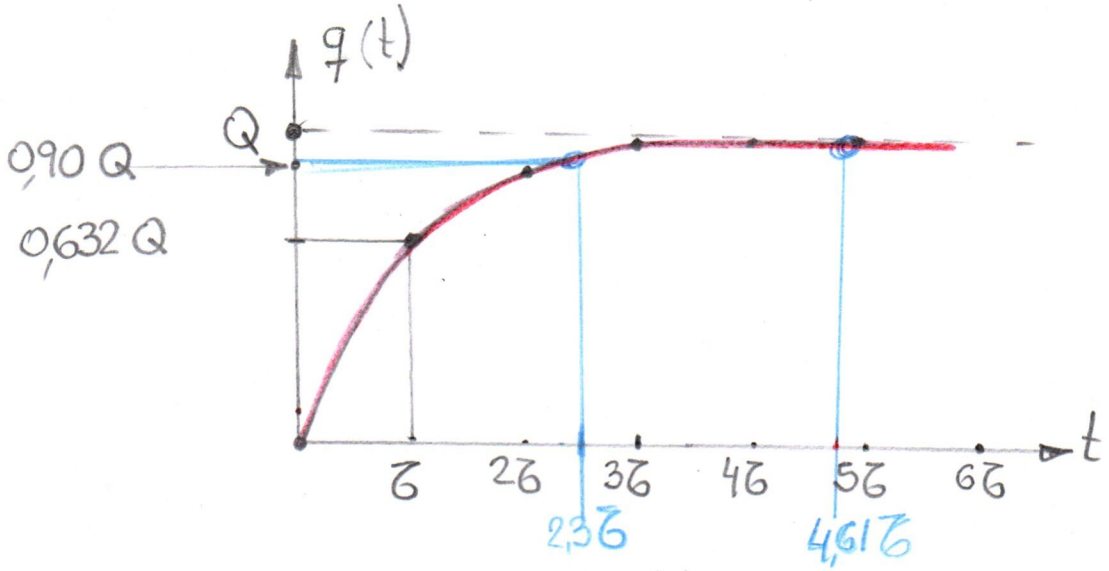
Se debe ajustar R para garantizar que circule una corriente $I = 1\,(mA)$ para un valor de V constante.

La resistencia $R_{12} = R_1 + R_2$ debe ser constante. Si R_1 diminuye R_2 aumenta en la misma proporción

21.1



$\tau = RC\ (s)$.



$$q(t) = Q\left(1 - e^{-t/\tau}\right)$$

a) $0{,}90\,Q = Q\left(1 - e^{-t/\tau}\right)$

$$e^{-t/\tau} = 1 - 0{,}90 = 0{,}10$$

$$-\frac{t}{\tau} = \ln 0{,}10$$

$$t = 2{,}3\,\tau$$

b) $0{,}99\,Q = Q\left(1 - e^{-t/\tau}\right)$

$$e^{-t/\tau} = 1 - 0{,}99 = 0{,}01$$

$$-\frac{t}{\tau} = \ln 0{,}01$$

$$t = 4{,}6\,\tau$$