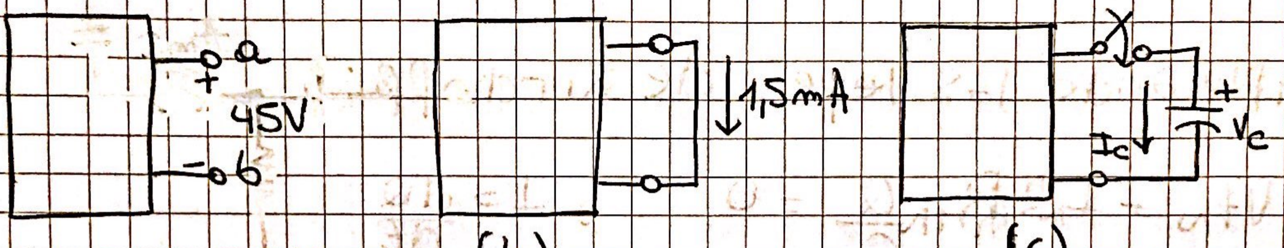
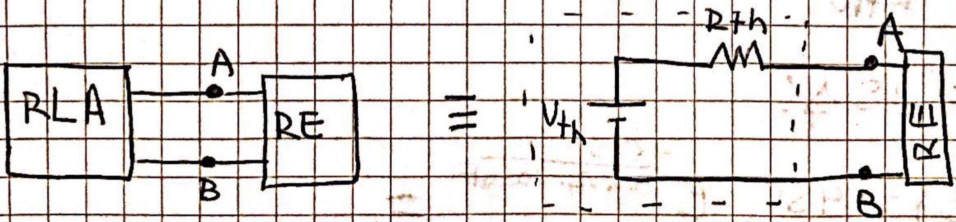
(4) Una caja megra contiene resistores y fuentes. Se la mide externamente y se obtienen los valores indicados. Luego se le conecta un capacitor de 500 uF mediante una llave. Determinar el valor de la corriente en el capacitor 25s después de conectar la llave.

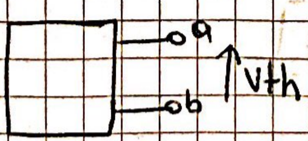


(a) (b) (c)

Usando el teorema de thévenin, podemos pensar a la caja como la red lineal activa

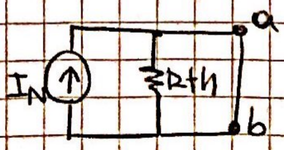


Entonces por (a) $V_{th} = 45V$.



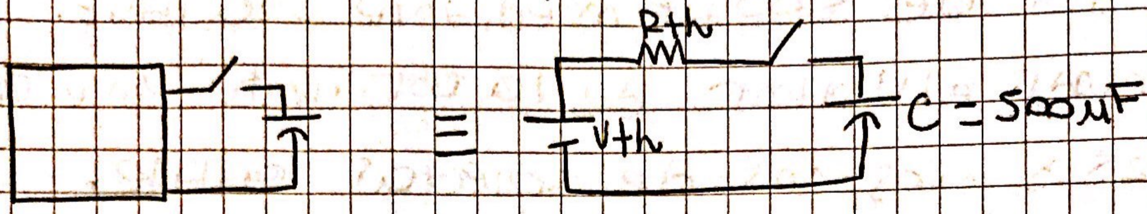
Análogamente, usando el teorema de Norton, por (b)

$I_N = 1,5 \, mA$



Además $R_{th} = \frac{V_{th}}{I_N} = \frac{45V}{1,5mA} = 30k\Omega$

Entonces (c) es equivalente a:



Aplicando las leyes de Kirchoff:

$V_{th} - IR_{th} - \frac{Q}{C} = 0 \quad , I = \frac{dQ}{dt}$

$\Rightarrow Q = C.V_{th}\left[1 - e^{(-t/R_{th}.C)}\right]$

$\Rightarrow \left[I = \frac{V_{th}}{R_{th}} e^{-t/R_{th}.C}\right]$

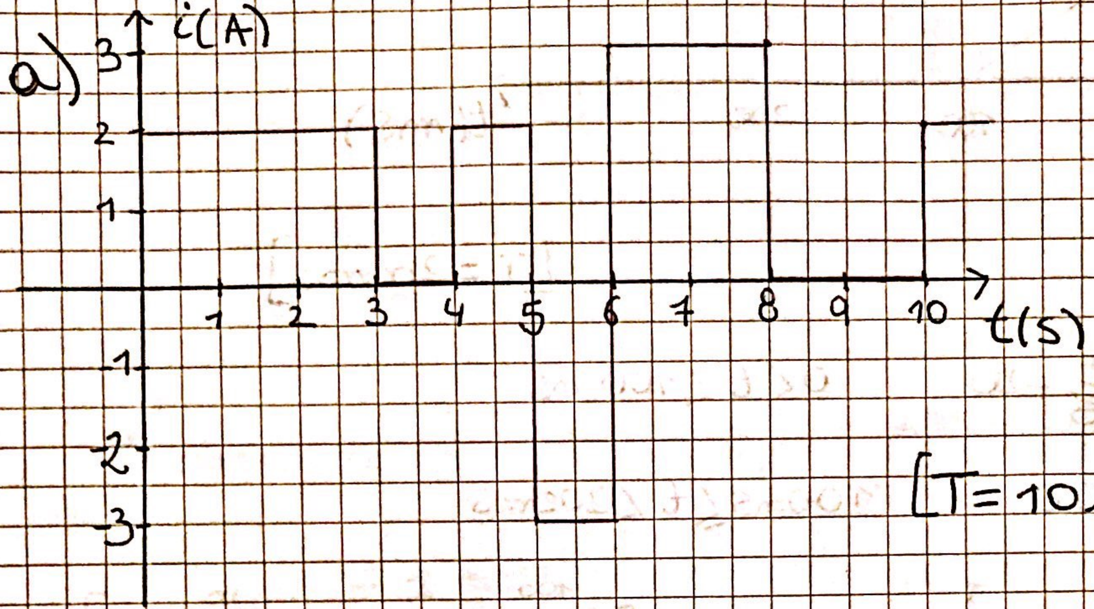
Para $t = 25s$:

$I(25s = t) = \frac{45V}{30k\Omega} . e^{-\frac{25s}{30k\Omega . 500\mu F}}$

$\left[I(25s) = 0,283\ mA\right]$

5) Determine los valores medio y eficaz de cada una de las formas de onda

a)



[T = 10 s]

Sabiendo que $I_{Medio} = \frac{1}{T} \cdot \int_0^T I\,dt$ y teniendo la función partida $I(t)$:

$$I_{Medio} = \frac{1}{10} \cdot \left[\int_0^3 2\,dt + \int_3^4 0\,dt + \int_4^5 2\,dt + \int_5^6 (-3)\,dt + \int_6^8 3\,dt + \int_8^{10} 0\,dt \right]$$

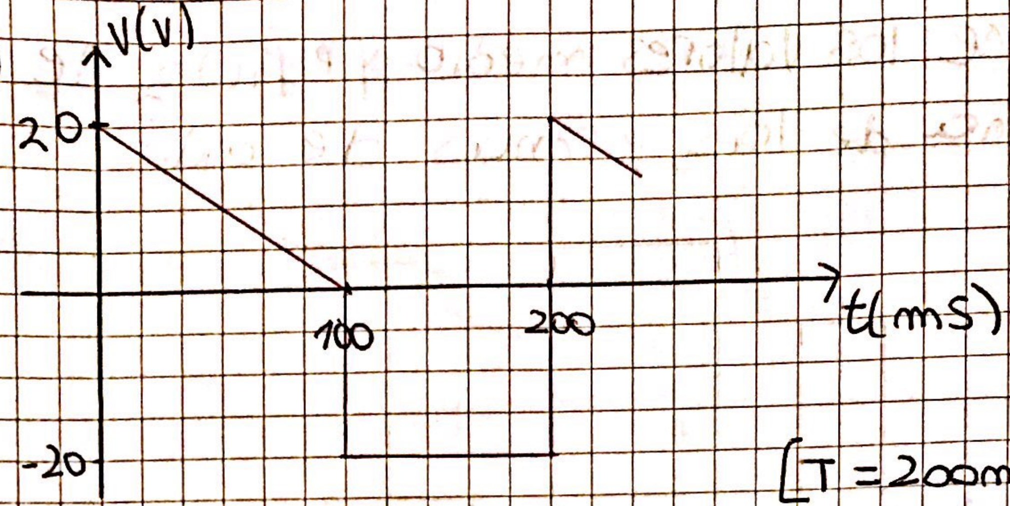
$$\Rightarrow \boxed{I_{Medio} = \frac{1}{10} \cdot 11A = 1{,}1A}$$

Por otro lado $I_{ef} = \sqrt{\frac{1}{T} \cdot \int_0^T I^2\,dt}$, entonces:

$$I_{ef} = \sqrt{\frac{1}{10} \cdot \int_0^{10} I^2\,dt} = \sqrt{\frac{1}{10} \cdot \left(\int_0^3 2^2\,dt + \int_4^5 2^2\,dt + \int_5^6 (-3)^2\,dt + \int_6^8 3^2\,dt \right)}$$

$$\Rightarrow \boxed{I_{ef} = \sqrt{\frac{43}{10}} \simeq 2{,}074A}$$

b)



$[T = 200ms]$

$$V(t) = \begin{cases} -\frac{t}{5} + 20 & 0 < t < 100\,ms \\ -20 & 100ms \leq t < 200ms \end{cases}$$

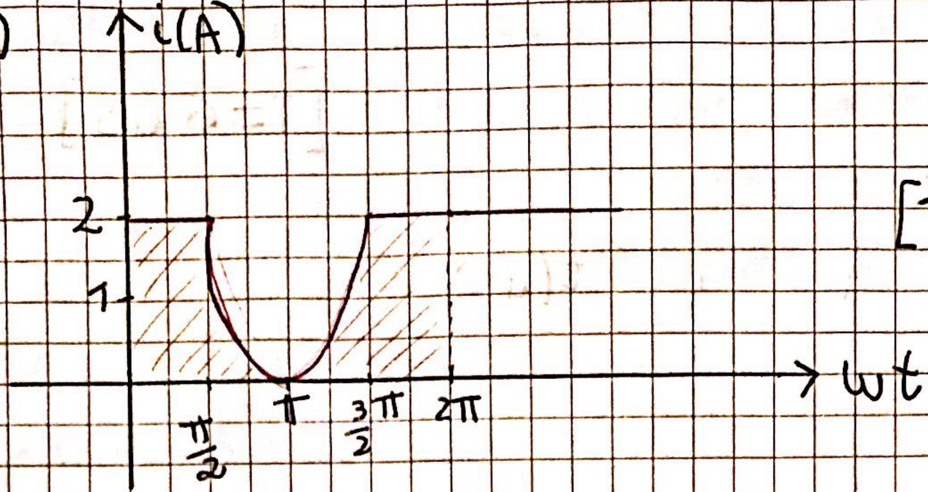
$$\cdot V_{Medio} = \frac{1}{T} \int_0^T V(t)\,dt = \frac{1}{200}\left[\int_0^{100} \left(-\frac{t}{5} + 20\right) dt + \int_{100}^{200} (-20)\,dt\right]$$

$$\left[V_{Medio} = \frac{1}{200} \cdot (-1000) = -5V\right]$$

$$\cdot V_{ef} = \sqrt{\frac{1}{T}\int_0^T V^2\,dt} = \sqrt{\frac{1}{200}\left(\int_0^{100}\left(-\frac{t}{5}+20\right)^2 dt + \int_{100}^{200} (-20)^2\,dt\right)}$$

$$\left[V_{ef} = \sqrt{\frac{1}{200} \cdot \frac{160000}{3}} \simeq 16{,}33V\right]$$

c)



$[T = 2\pi]$

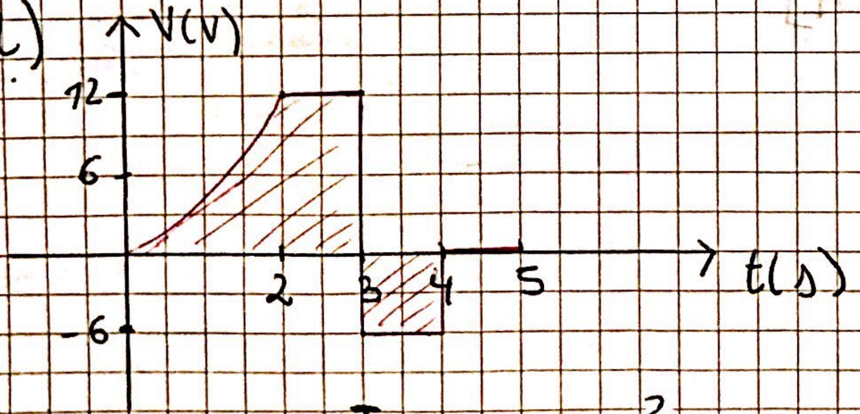
$\bullet\ I_{Medio} = \frac{1}{T}\int_0^T I\,dt = \frac{1}{2\pi}\cdot\left[\int_0^{\frac{\pi}{2}} 2\,dt + \int_{\frac{\pi}{2}}^{3/2\pi}(2\cos(t)+2)\,dt + \int_{\frac{3}{2}\pi}^{2\pi} 2\,dt\right]$

$[I_{Medio} \cong 1{,}36\,A]$

$\bullet\ I_{ef} = \sqrt{\frac{1}{T}\int_0^T I^2\,dt} = \sqrt{\frac{1}{2\pi}\left(2\int_0^{\frac{\pi}{2}} 2^2\,dt + \int_{\frac{\pi}{2}}^{3/2\pi}(2\cos(t)+2)^2\,dt\right)}$

$[I_{ef} \cong 1{,}57\,A]$

d)



$[T = 4\,s]$

$$V(t) = \begin{cases} 3t^2 & 0 < t < 2 \\ 12 & 2 < t < 3 \\ -6 & 3 < t < 4 \end{cases}$$

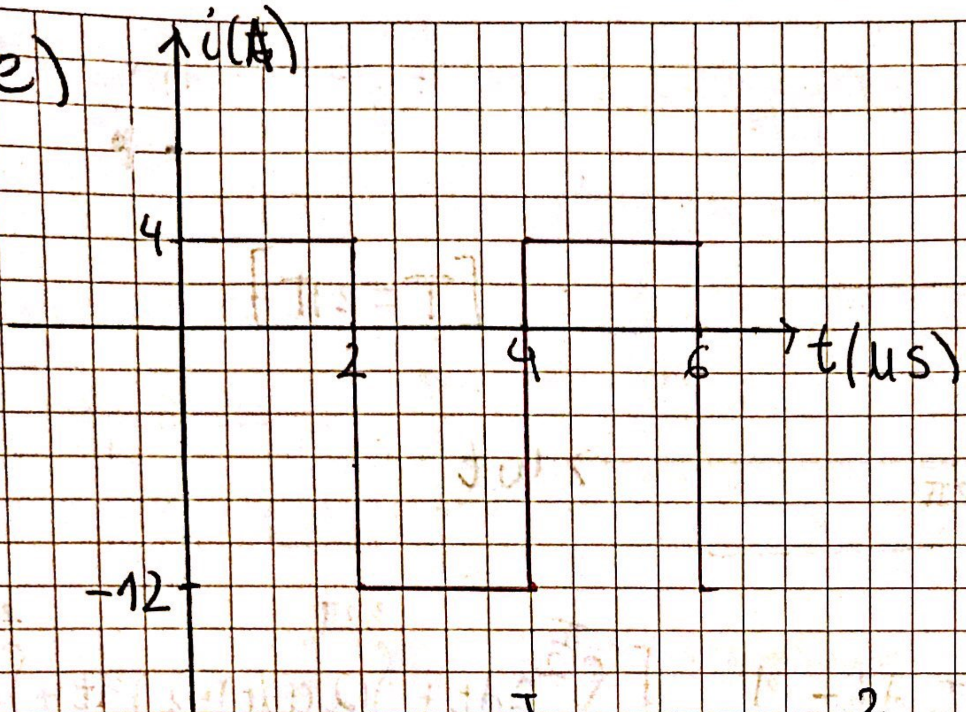
$\bullet\ V_{Medio} = \frac{1}{T}\int_0^T V\,dt = \frac{1}{4}\left(\int_0^2 3t^2\,dt + \int_3^4 (-6)\,dt + \int_2^3 12\,dt\right)$

$[V_{Medio} = 3{,}5\ V]$

$\bullet\ V_{ef} = \sqrt{\frac{1}{T}\cdot\left(\int_0^T V^2\,dt\right)} = \sqrt{\frac{1}{4}\left(\int_0^2 (3t^2)^2\,dt + \int_3^4 (-6)^2\,dt + \int_2^3 12^2\,dt\right)}$

$[V_{ef} \cong 7{,}7\,V]$

e)



$[T = 6\,\mu s]$

$\bullet\ I_{Medio} = \frac{1}{T}\int_0^T I\,dt = \frac{1}{6}\left(\int_0^2 4\,dt + \int_2^4 (-12)\,dt + \int_4^6 4\,dt\right)$

$[I_{Medio} \cong -1{,}33\,A]$

$\bullet\ I_{ef} = \sqrt{\frac{1}{T}\cdot\int_0^T I^2\,dt} = \sqrt{\frac{1}{6}\left(\int_0^2 4^2\,dt + \int_2^4 (-12)^2\,dt + \int_4^6 4^2\,dt\right)}$

$[I_{ef} \cong 7{,}66\,A]$