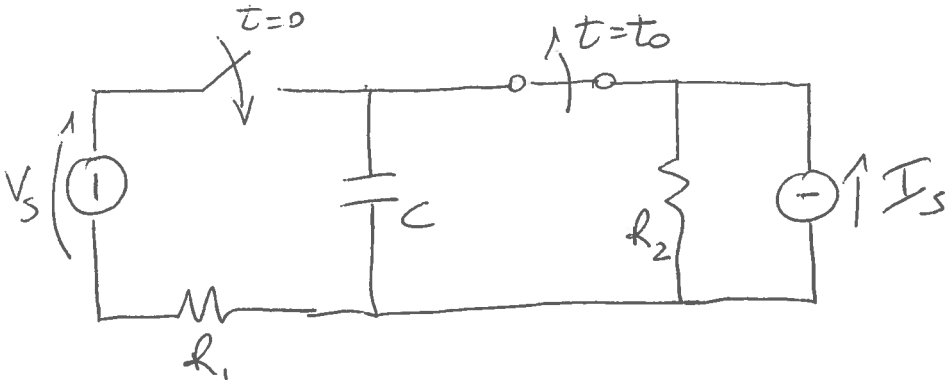
ES 27



$V_s = 120\,V$

$I_s = 30\,A$

$R_1 = 5\,\Omega$

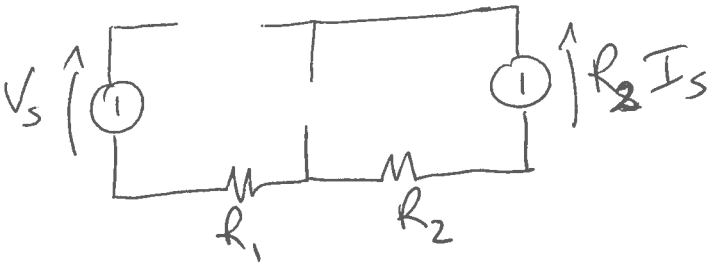
$R_2 = 10\,\Omega$

$C = 12\,\mu F$

$t_0 = 50\,\mu s$

1° transitorio

$t = 0^-$

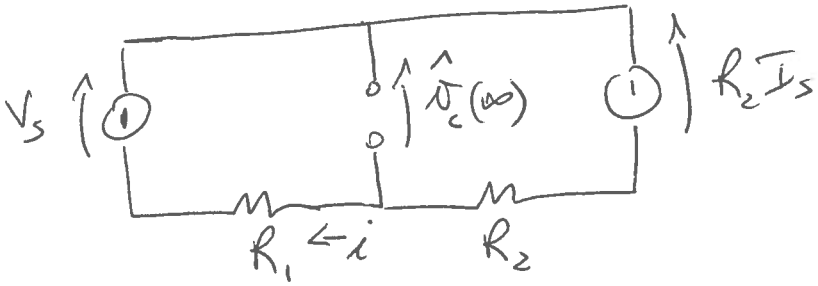


$i_c(0^-) = 0$

$v_c(0^-) = v_c(0^+) = R_2 I_s$

$= 300\,V$

$t = \infty$ (come se il secondo transitorio non ci fosse)

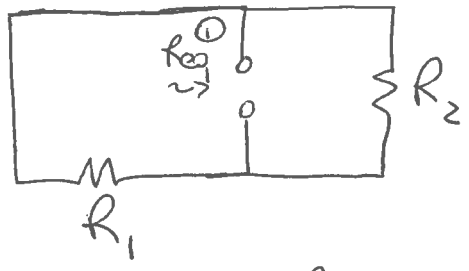


$$i = \frac{V_s - R_2 I_s}{R_1 + R_2}$$

$$\hat{v}_c(\infty) = V_s - R_1 i = V_s - R_1 \frac{V_s - R_2 I_s}{R_1 + R_2} = \frac{V_s R_2 - R_1 R_2 I_s}{R_1 + R_2}$$

$$= 180\,V$$

$$\tau_1 = R_{eq}^{(1)} C$$



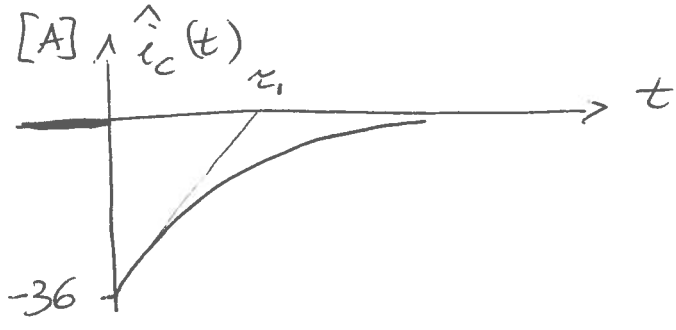
$$R_{eq}^{(1)} = \frac{R_1 R_2}{R_1 + R_2}$$

$$\tau_1 = R_{eq}^{(1)} C = \frac{R_1 R_2 C}{R_1 + R_2} = 40\,\mu s$$

$$\hat{v}_c(t) = \left[v_c(0) - \hat{v}_c(\infty)\right] \exp\left(-\frac{t}{\tau_1}\right) + \hat{v}_c(\infty)$$

$$= 120 \exp\left(-\frac{t(R_1+R_2)}{R_1 R_2 C}\right) + 180\,V$$

$$\hat{i}_c(t) = C \frac{d\hat{v}_c}{dt} = -36 \exp\left(-\frac{t}{\tau_1}\right) A$$



2° transitorio

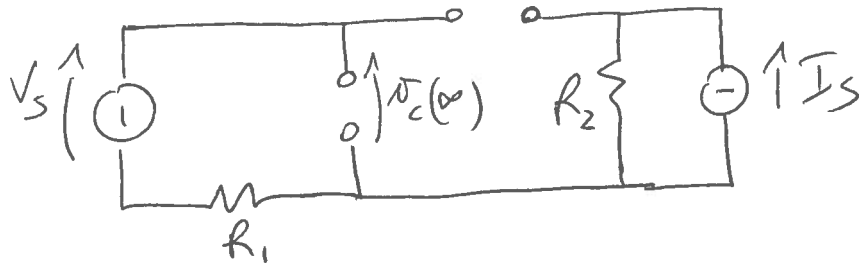
$t_0 = 50\,\mu s$

$$v_c(t_0^-) = \hat{v}_c(t_0^-) = 120\exp\left(-\frac{5}{4}\right) + 180 = 214,38\ V$$

$$i_c(t_0^-) = \hat{i}_c(t_0^-) = -36\exp\left(-\frac{5}{4}\right) = -10,31\ A$$

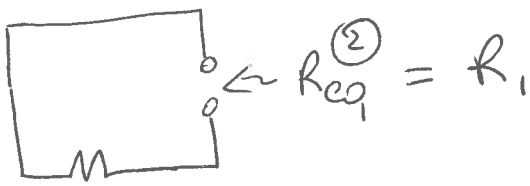
$$v_c(t_0^+) = v_c(t_0^-) = 214,38\ V$$

$t = +\infty$



$$v_c(\infty) = V_s = 120\,V$$

τ_2



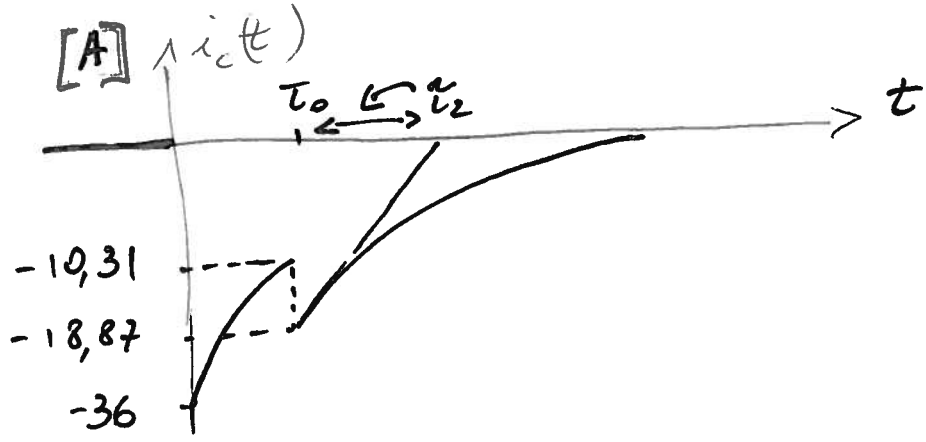
$$\tau_2 = R_1 C = 60\,\mu s$$

$$v_c(t) = (214,38 - 120)\exp\left(-\frac{t-t_0}{\tau_2}\right) + 120\ V$$

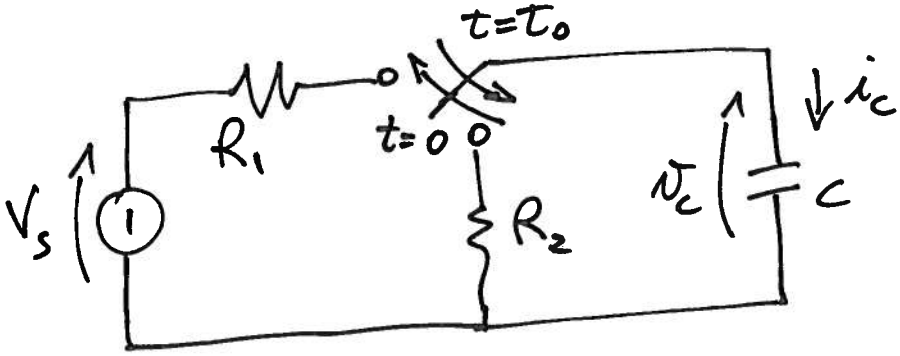
$$= 94,38\exp\left(-\frac{t-t_0}{\tau_2}\right) + 120\ V$$

$$i_c(t) = C\frac{dv_c}{dt} = -18,876\exp\left(-\frac{t-t_0}{\tau_2}\right)\ A$$

$i_c(t_0^+) = -18,876\ A$



ES 28 (FLASH FOTOGRAFICO)



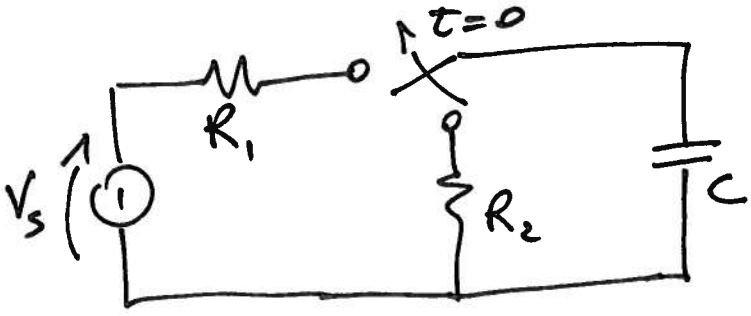
$v_c(0) = 0$

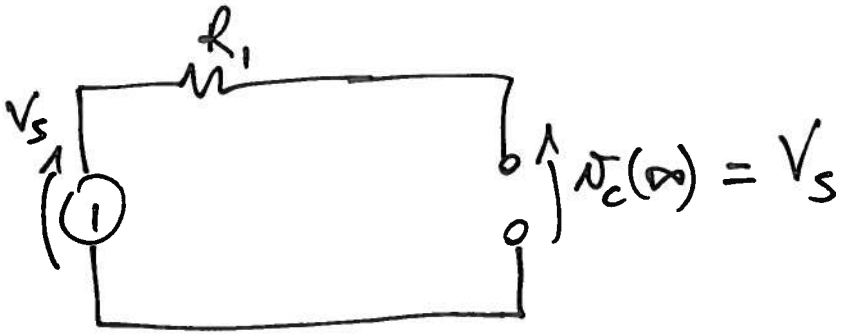
V_s - Tensione elevata

R_1 - resistore di resistenza elevata (⇒ limitatore di corrente nella fase di carica)

R_2 - lampada del flash, resistenza piccola

1) fase di carica $0 < t < t_0 << 5\tau_1$





$\tau_1 = R_1 C$, elevata

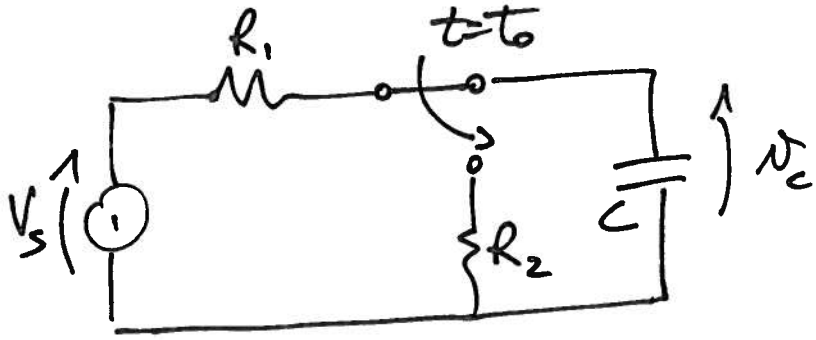
$$v_c(t) = \left[v_c(0) - v_c(\infty)\right] \exp\left(-\frac{t}{\tau_1}\right) + v_c(\infty)$$

$$= V_s \left[1 - \exp\left(-\frac{t}{\tau_1}\right)\right]$$

$$i_c(t) = C \frac{dv_c}{dt} = \frac{V_s C}{R_1 C} \exp\left(-\frac{t}{\tau_1}\right)$$

$$= \frac{V_s}{R_1} \exp\left(-\frac{t}{\tau_1}\right)$$

2) fase di scarica



$t = t_0 \quad v_c(t_0) = V_s \quad (t_0 \gg 5\tau_1)$

$v_c(\infty) = 0$

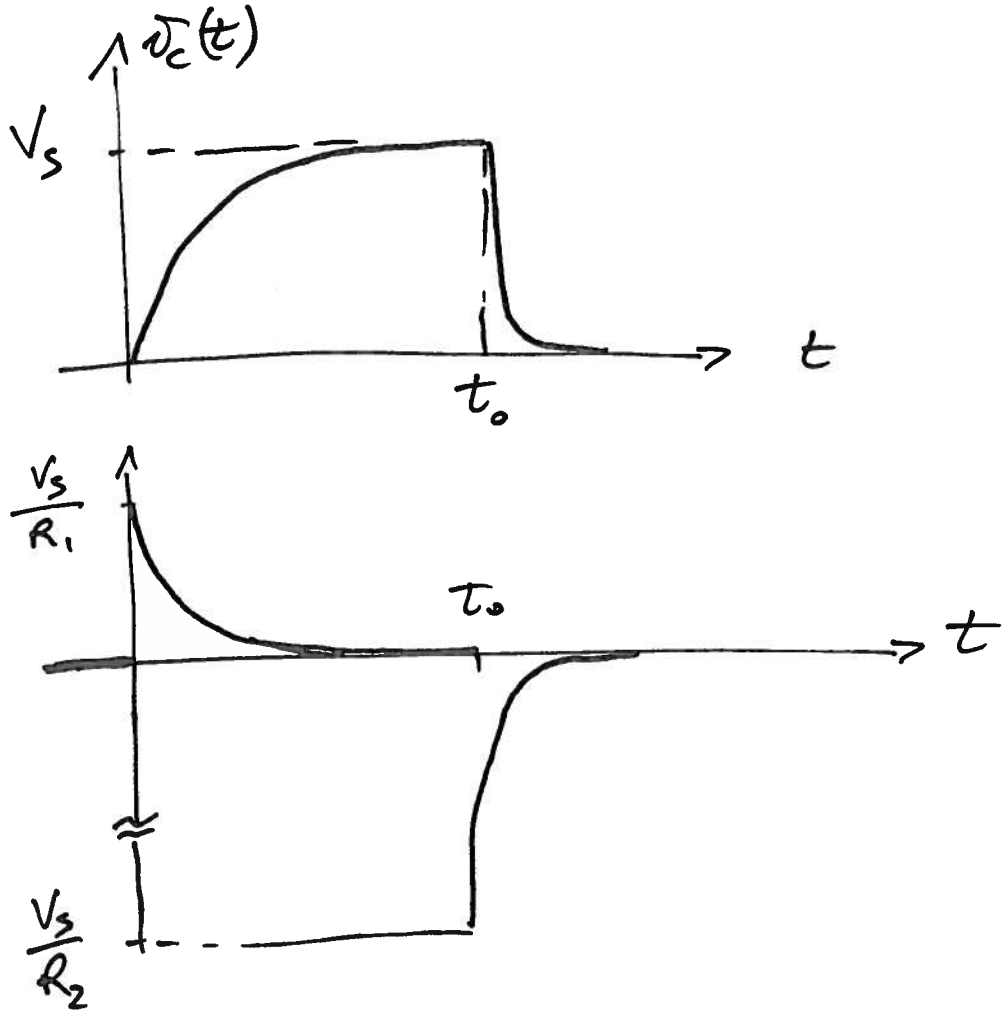
$\tau_2 = R_2 C$, piccola

$$v_c(t) = \left[v_c(t_0) - v_c(\infty)\right] \exp\left(-\frac{t-t_0}{\tau_2}\right) + v_c(\infty)$$

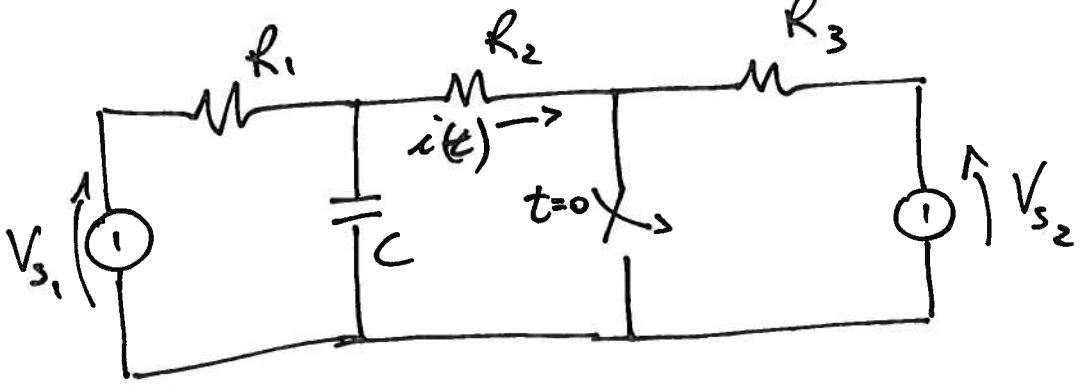
$$= V_s \exp\left(-\frac{t-t_0}{\tau_2}\right)$$

$$i_c(t) = C\frac{dv_c}{dt} = -\frac{V_s C}{R_2 C} \exp\left(-\frac{t-t_0}{\tau_2}\right)$$

$$= -\frac{V_s}{R_2} \exp\left(-\frac{t-t_0}{\tau_2}\right)$$



ES 29



$V_{s_1} = 36\,V$

$V_{s_2} = 12\,V$

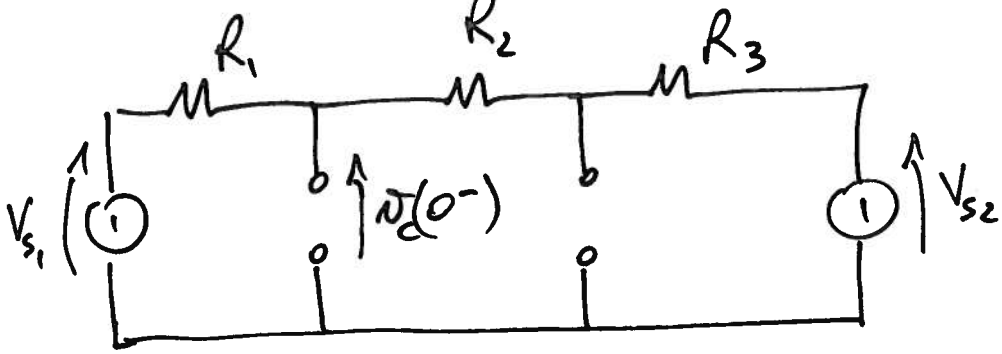
$R_1 = 2\,k\Omega$

$R_2 = 6\,k\Omega$

$R_3 = 4\,k\Omega$

$C = 100\,\mu F$

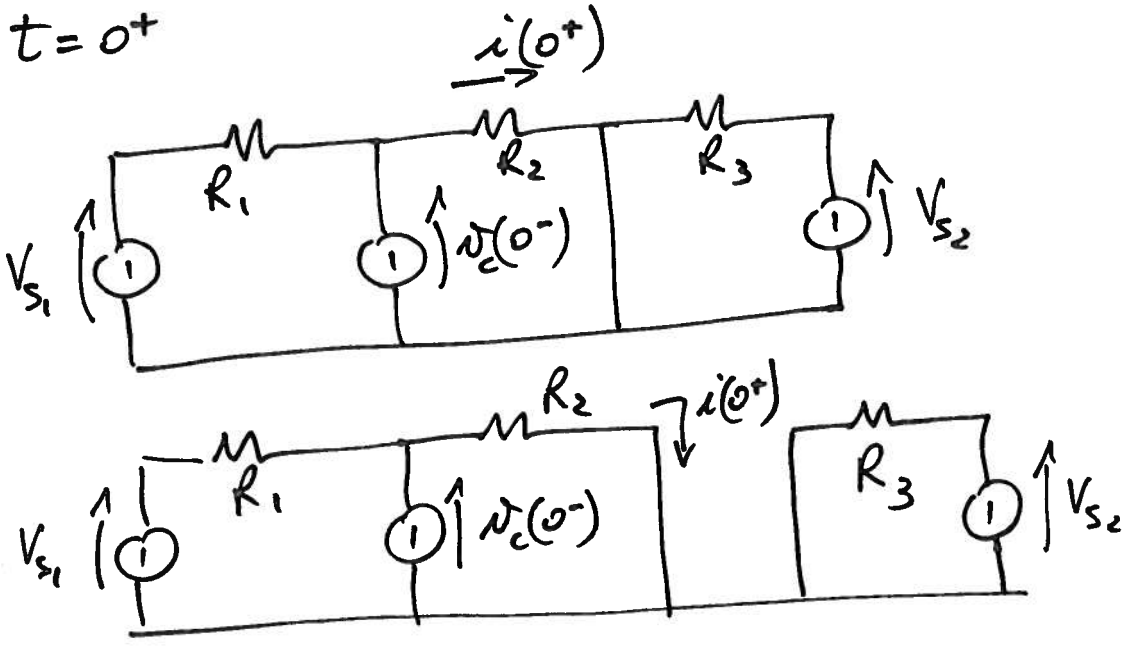
$t = 0^-$



$$i(0^-) = \frac{V_{s_1} - V_{s_2}}{R_1 + R_2 + R_3} = 2\,mA$$

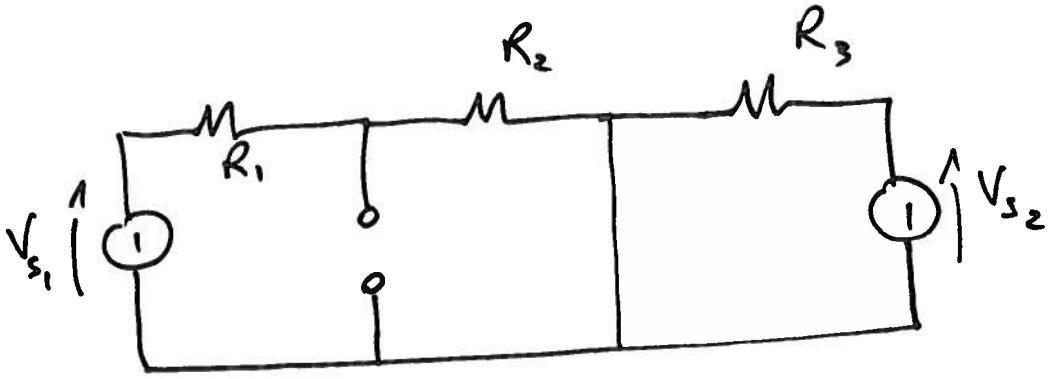
$$v_c(0^-) = V_{s_1} - R_1\, i(0^-) = 32\,V$$

$t = 0^+$



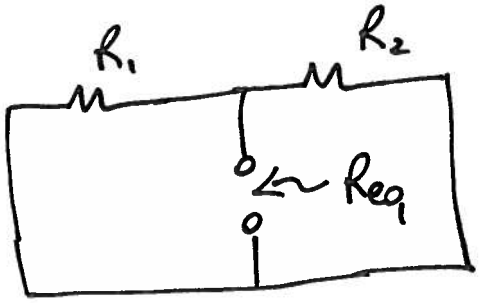
$$i(0^+) = \frac{v_c(0^-)}{R_2} = \frac{16}{3}\ mA$$

$t = \infty$



$$i(\infty) = \frac{V_{s1}}{R_1 + R_2} = \frac{9}{2}\ mA$$

τ



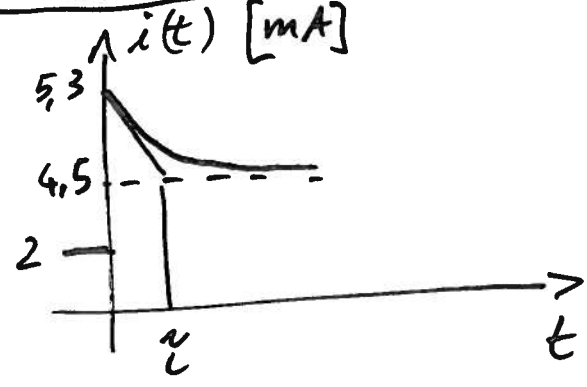
$$R_{eq} = \frac{R_1 R_2}{R_1 + R_2} = \frac{3}{2}\ k\Omega$$

$$\tau = R_{eq} C = 150\ ms$$

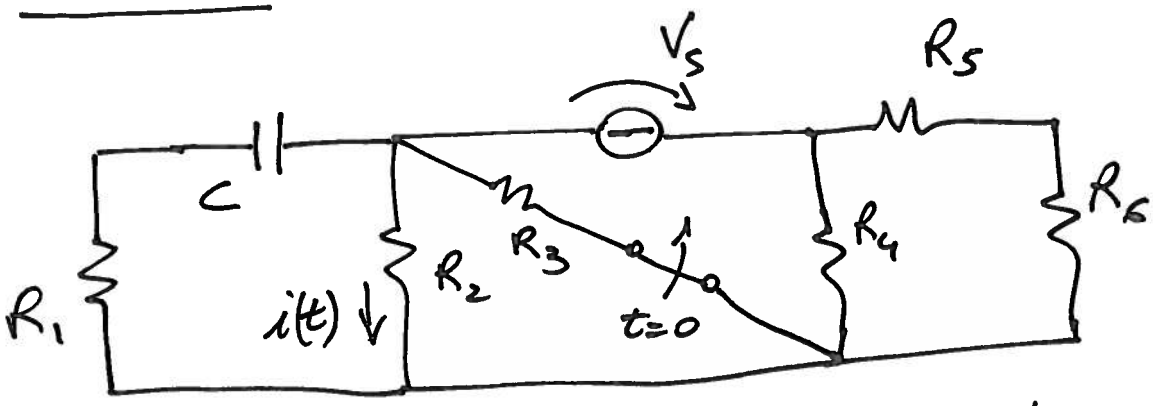
$$i(t) = [i(0^+) - i(\infty)] \exp\left(-\frac{t}{\tau}\right) + i(\infty)$$

$$= \left(\frac{16}{3} - \frac{9}{2}\right) \exp\left(-\frac{t}{\tau}\right) + \frac{9}{2}\ mA$$

$$= \frac{5}{6} \exp\left(-\frac{t}{\tau}\right) + \frac{9}{2}$$



ES 30



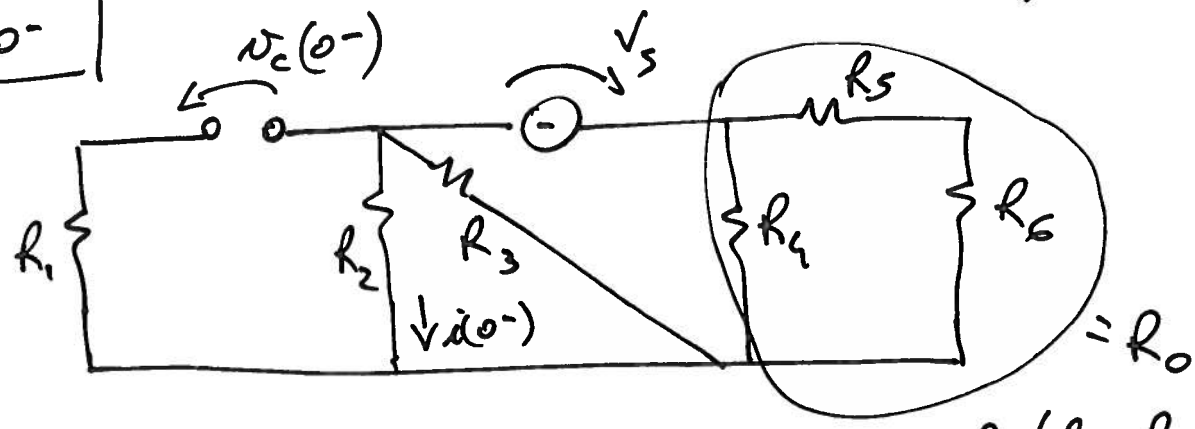
$V_S = 10\,V$

$R_1 = R_5 = R_6 = 5\,\Omega$

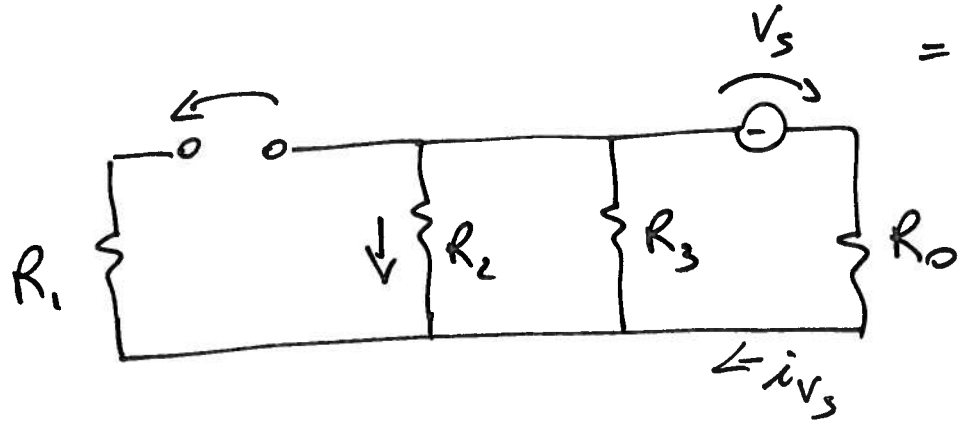
$R_2 = R_3 = R_4 = 10\,\Omega$

$C = 10\,\mu F$

$t = 0^-$



$$R_0 = \frac{R_4(R_5+R_6)}{R_4+R_5+R_6} = 5\,\Omega$$



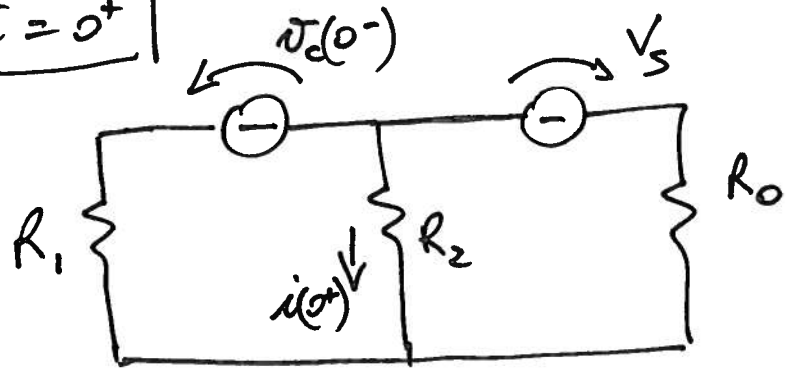
$$i_{V_S} = \frac{V_S}{R_0 + \dfrac{R_2 R_3}{R_2+R_3}} \Rightarrow i(0^-) = -\frac{R_3}{R_2+R_3}\, i_{V_S}$$

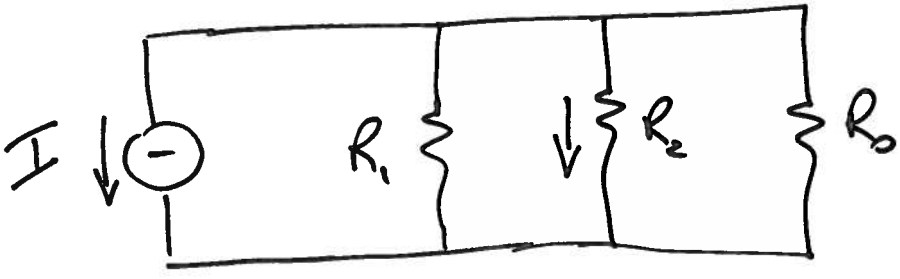
$$i(0^-) = -\frac{R_3 V_s}{R_2 R_3 + R_0(R_2+R_3)} = -0{,}5\,A$$

$$v_c(0^-) = -R_2\, i(0^-) = \frac{R_2 R_3 V_s}{R_2 R_3 + R_0(R_2+R_3} = 5\,V$$

$$v_c(0^+) = v_c(0^-)$$

$t = 0^+$





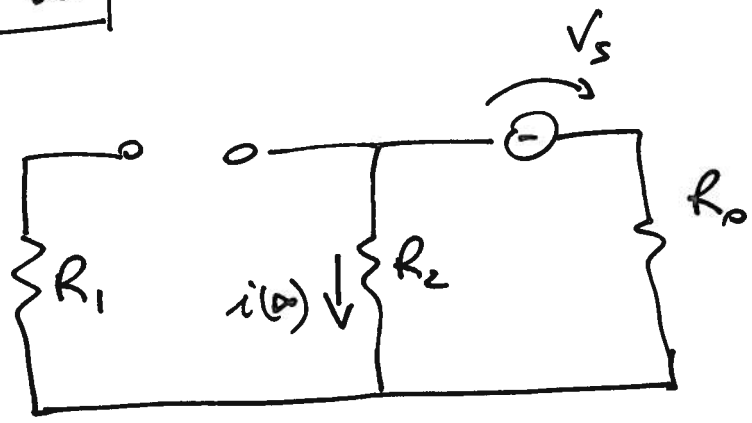
$$I = \frac{V_s}{R_0} + \frac{v_c(0^-)}{R_1}$$

$$i(0^+) = -\frac{1}{R_2} I \frac{1}{\frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_0}}$$

$$= -\left(\frac{V_s}{R_0} + \frac{v_c(0^-)}{R_1}\right) \frac{R_1 R_0}{R_1 R_2 + R_1 R_0 + R_2 R_0}$$

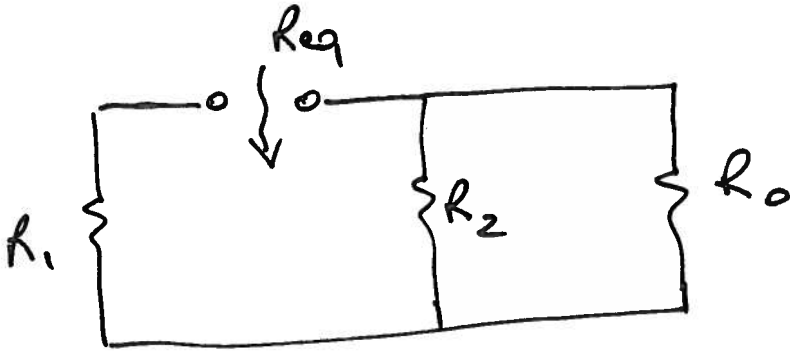
$$= -0{,}6\,A$$

$t \to \infty$



$$i(\infty) = -\frac{V_s}{R_2 + R_0} = -0{,}67\ A$$

τ



$$R_{eq} = R_1 + \frac{R_2 R_0}{R_0 + R_2} = 8{,}33\ \Omega$$

$$\tau = R_{eq} C = 83{,}3\ \mu s$$

$$i(t) = [i(0^+) - i(\infty)] \exp\left(-\frac{t}{\tau}\right) + i(\infty)$$

$$= -0{,}07 \exp\left(-\frac{t}{\tau}\right) - 0{,}67\ A$$