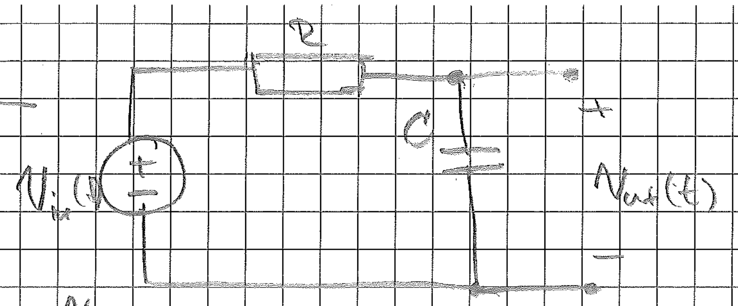
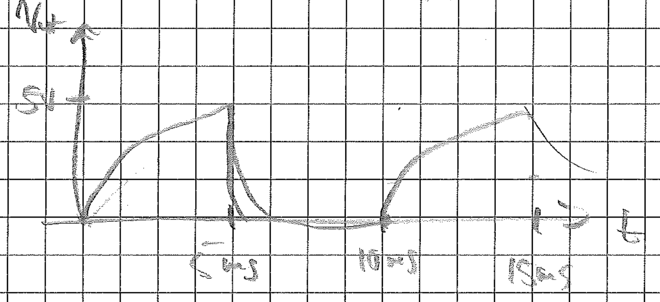
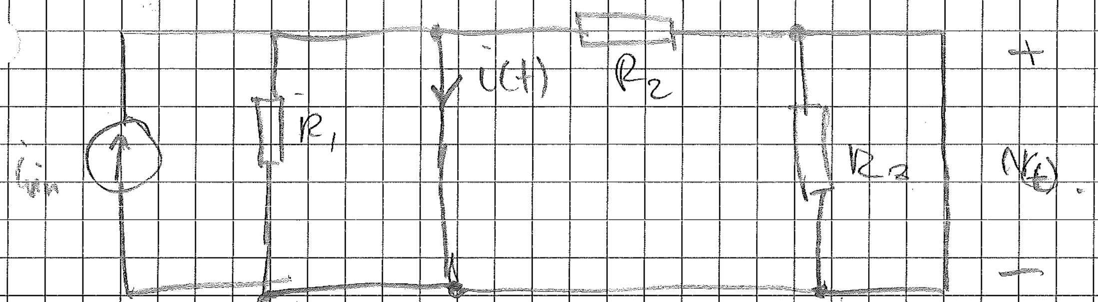
9.1





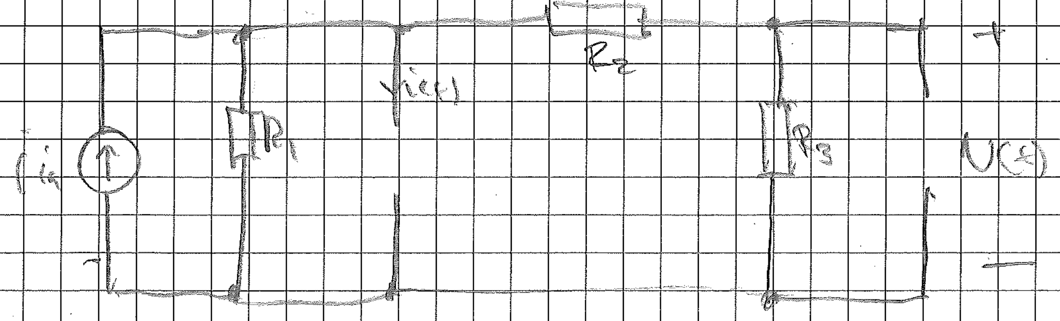
9.3. $i_{in} = \begin{cases} i_0 & t \geq 0 \\ 0 & t < 0 \end{cases}$

För $t = 0^+$ ersätter vi kondensatorerna med kortslutningar.



Detta ger $i(0^+) = I_0$; $v(0^+) = 0$.

För $t \to \infty$ ersätter vi kondensatorerna med avbrott

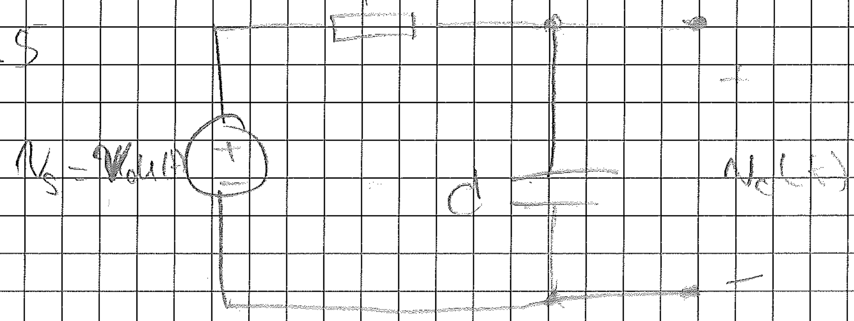


$\lim_{t \to \infty} i(t) = 0$

Strömgrening: $i = \frac{R_1}{R_1 + R_2 + R_3} I_0 = \lim_{t \to \infty} v(t) = \frac{R_1 R_3}{R_1 + R_2 + R_3} I_0 =$

$= \frac{R_1 R_3}{R_1 + R_2 + R_3} I_0.$

9.5



$v_s = v_0 \Theta(t)$

a) $v_0 \Theta(t) = R i(t) + v_c(t)$

$i(t) = C\frac{dv_c}{dt} \Rightarrow v_c + RC\frac{dv_c}{dt} = v_0\Theta(t)$

$\Rightarrow v_c' + \frac{1}{RC}v_c = \frac{1}{RC}v_0\Theta(t)$. Denna ODE löses med integrerande faktor:

$v_c(t)e^{\frac{1}{RC}t} = \frac{1}{RC}\int v_0 e^{\frac{1}{RC}t}\,dt\,\Theta(t) = \frac{\cancel{RC}}{\cancel{RC}}v_0 e^{\frac{1}{RC}t} + B \Rightarrow$

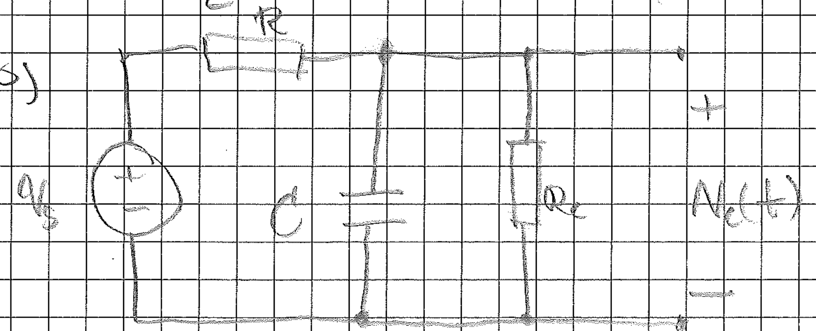
$\Rightarrow v_c(t) = (v_0 + Be^{-\frac{1}{RC}t})\Theta(t)$. BV $v_c(0) = 0$ ger

$v_0 + B = 0 \Rightarrow B = -v_0 \Rightarrow v_c(t) = v_0(1 - e^{-\frac{1}{RC}t})\Theta(t)$

$v_c = \frac{v_0}{2} \Rightarrow \frac{v_0}{2} = v_0(1 - e^{-\frac{1}{RC}t}) \Rightarrow \frac{1}{2} = 1 - e^{-\frac{1}{RC}t}$

$\Rightarrow \frac{1}{2} = e^{-\frac{1}{RC}t} \Rightarrow e^{\frac{1}{RC}t} = 2 \Rightarrow \frac{1}{RC}t = \ln 2 \Rightarrow \boxed{t = RC\ln 2}$

b)



$v_s = v_0\Theta(t)$

$v_0\Theta(t) = Ri(t) + v_c(t)$

$i(t) = \frac{v_c(t)}{R_L} + C\frac{dv_c}{dt}$

$\Rightarrow v_c(t) + \frac{Rv_c(t)}{R_L} + RC\frac{dv_c}{dt} = v_0\Theta(t)$

$\Rightarrow v_c' + \left(\frac{1}{RC} + \frac{1}{R_L C}\right)v_c = \frac{1}{RC}v_0\Theta(t)$

Sätter $\frac{1}{RC} + \frac{1}{R_c C} = \alpha$

ger

$$N_c' + \alpha N_c = \frac{1}{RC} N_0 \Theta(t)$$ Denna ODE löses med IF:

$$= N_c(t) e^{\alpha t} = \frac{1}{RC} \int N_0 e^{\alpha t} dt \, \Theta(t)$$

$$\Rightarrow N_c(t) = \left(\frac{1}{RC\alpha} N_0 + \beta e^{-\alpha t}\right)\Theta(t)$$ BV $N_c(0) = 0$ ger:

$$N_c(0) = 0 = \frac{1}{RC\alpha} N_0 + \beta \Rightarrow \beta = \frac{1}{RC\alpha}$$

Då får vi:

$$N_c(t) = \frac{1}{RC} \cdot \frac{1}{\frac{1}{RC} + \frac{1}{R_c C}} N_0 + \frac{1}{RC} \cdot \frac{1}{\frac{1}{RC} + \frac{1}{R_c C}} e^{-\left(\frac{1}{RC} + \frac{1}{R_c C}\right)t} =$$

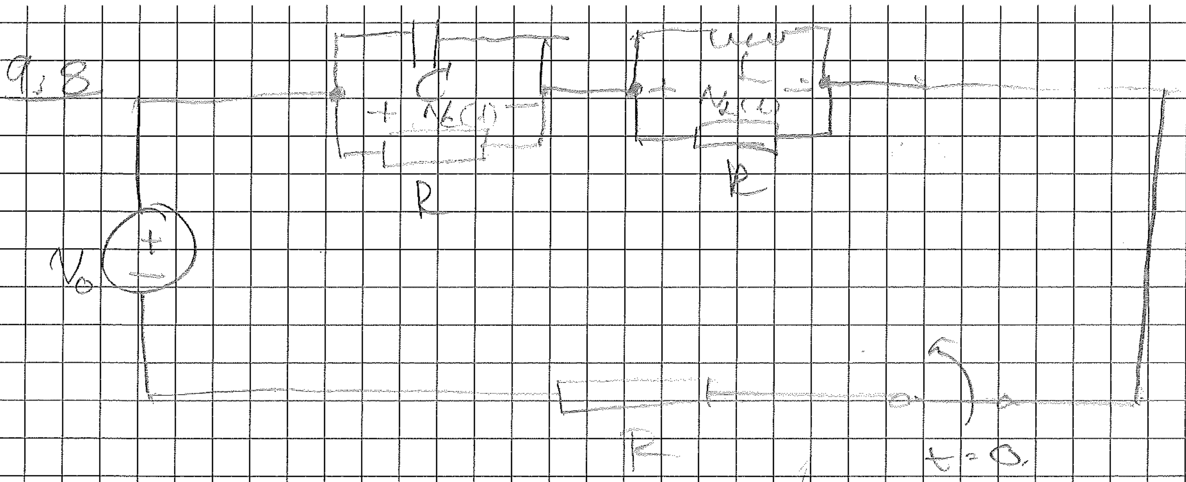
$$= \left[\frac{1}{\frac{1}{RC} + \frac{1}{R_c C}} = \frac{1}{\frac{R_c C + RC}{RR_c C^2}} = \frac{RR_c C^2}{\cancel{C}(R_c + R)} = \frac{RCR_c}{R + R_c}\right] =$$

$$= \frac{1}{\cancel{RC}} \cdot \frac{\cancel{RC} R_c}{R + R_c} N_0 + \frac{1}{\cancel{RC}} \cdot \frac{\cancel{RC} R}{R + R_c} e^{-\left(\frac{1}{RC} + \frac{1}{R_c C}\right)t} =$$

$$= \frac{R_c}{R + R_c} N_0 + \frac{R_c}{R + R_c} e^{-\left(\frac{1}{RC} + \frac{1}{R_c C}\right)t}.$$

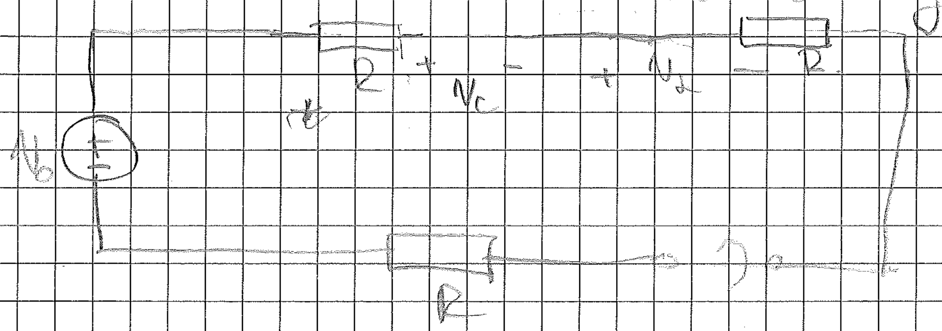
Nåt i'g missat

9.8



a) Likström ; Kondensator : Avbrott

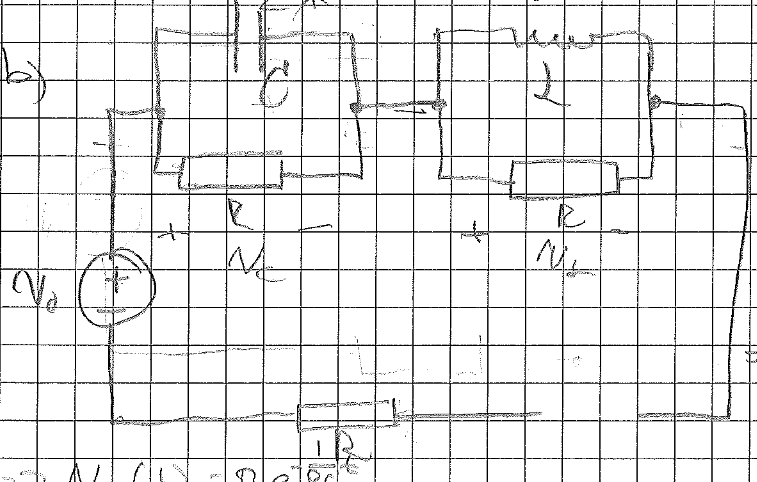
Spole : kortslutning



Detta ger $v_L(0^-) = 0$

$$v_C = \frac{R}{2R} v_0 = \frac{v_0}{2} = v_C(0^-)$$

b)



v_C

$$v_C(t) = R \cdot i_C(t) = -RC\frac{dv_C(t)}{dt}$$

$$\Rightarrow \begin{cases} v_C'(t) + \frac{1}{RC} v_C(t) = 0 \\ v_C(0) = \frac{v_0}{2} \end{cases}$$

$$\Rightarrow v_C(t) = Be^{-\frac{1}{RC}t}$$

$$v_C(0) = \frac{v_0}{2} = B \Rightarrow v_C(t) = \frac{v_0}{2} e^{-\frac{1}{RC}t}$$

v_L $\quad v_L(t) = -Ri_L = L\frac{di_L}{dt}$

Ger $\rightarrow$ $i_L' + \frac{R}{L} i_L = 0$.

BV: $i(0) = \frac{v_0}{2R}$

Så: $\begin{cases} i_L' + \frac{R}{L} i_L = 0 \\ i_L(0) = \frac{v_0}{2R} \end{cases}$