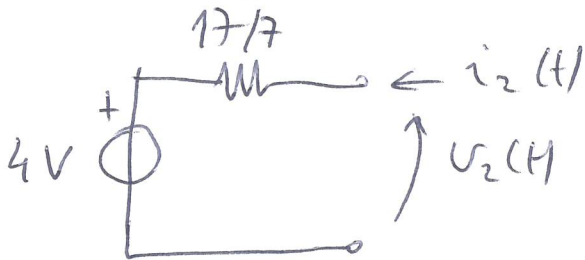
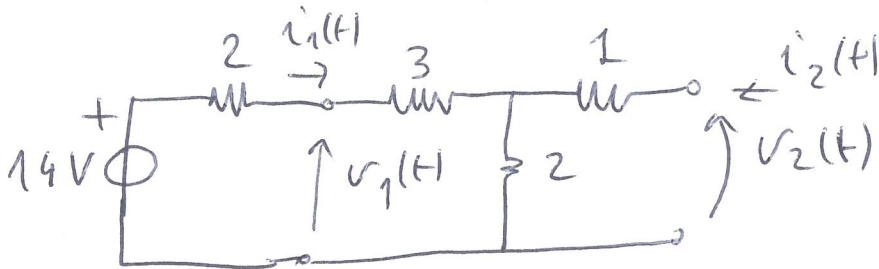
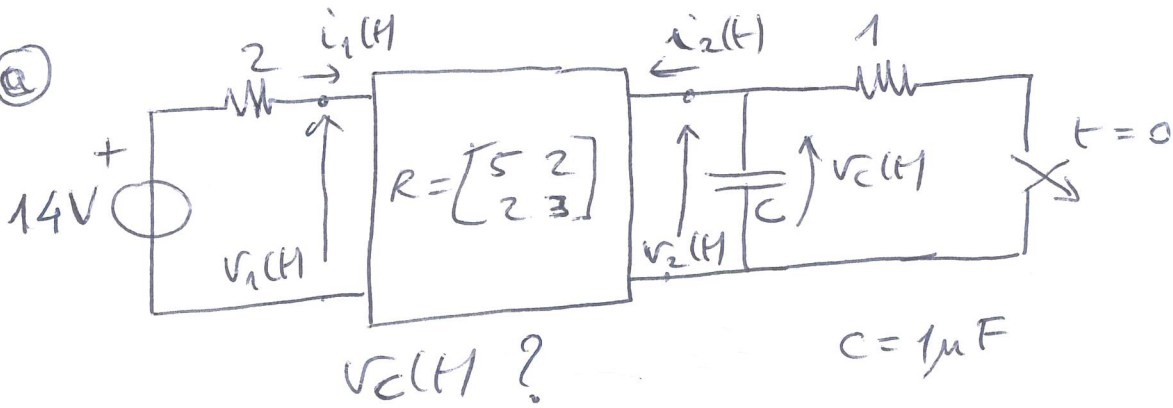


TRANSITORI I ORDINE (TEMPO)

2) a)

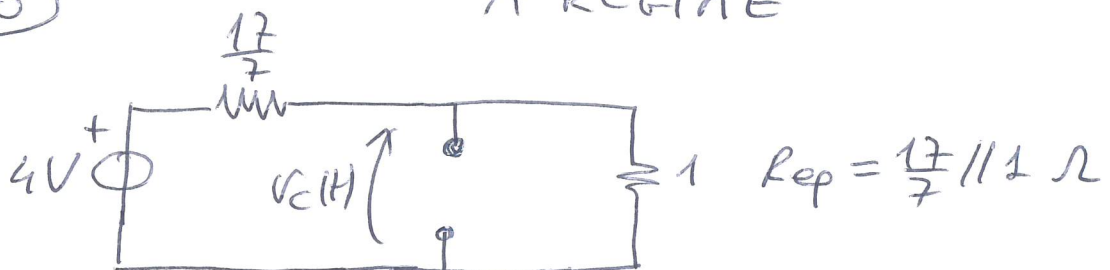


$$\begin{cases} v_1(t) = 5i_1(t) + 2i_2(t) \\ v_2(t) = 2i_1(t) + 3i_2(t) \\ v_2(t) = -2i_1(t) + 14 \end{cases}$$

$$v_2(t) = \frac{17}{7}i_2(t) + 4$$

$t < 0$

A REGIME



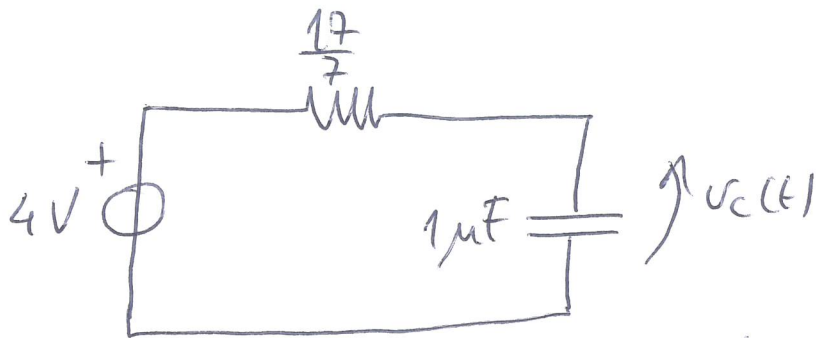
$$V_{eq}(t) = v_C(t) = \frac{1}{1 + \frac{17}{7}} 4 = \frac{7}{6} V \quad (\text{REGIME})$$

TRANSITORI I ORDINE (TEMPO)

2) (b)

$$t \geq 0$$

$$v_c(0) = \frac{7}{6} V$$



$$v_c(t) = [V_0 - v_c^p(0)] e^{-t/\tau_c} + v_c^p(t)$$

$t \geq 0$

$$V_0 = v_c(0) = \frac{7}{6} V$$

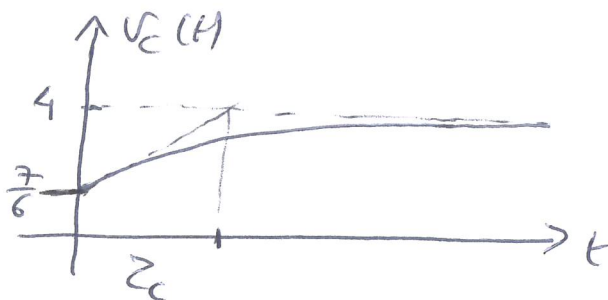
$$\tau_c = RC = \frac{17}{7} \times 10^{-6} = \frac{17}{7} \mu s$$

$$v_c^p(t) = 4 V$$

$$v_c(t) = \left[\frac{7}{6} - 4 \right] e^{-t/\tau_c} + 4 V$$

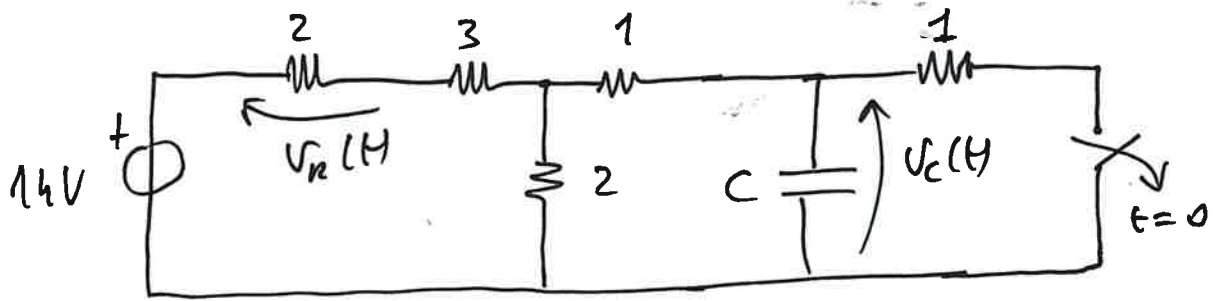
$t \geq 0$

$-\frac{17}{6}$



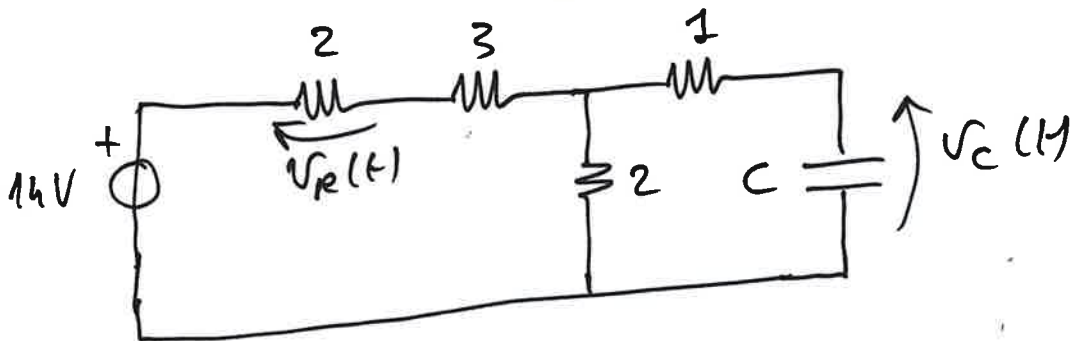
TRANSITORI I ORDINE (TEMPO)

2) c

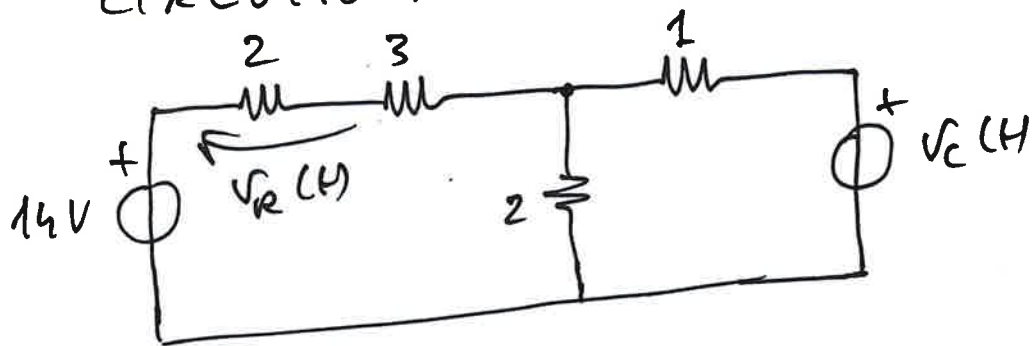


per $t \geq 0$ INTERRUPTORE APERTO

$$v_C(0) = \frac{7}{6} V$$



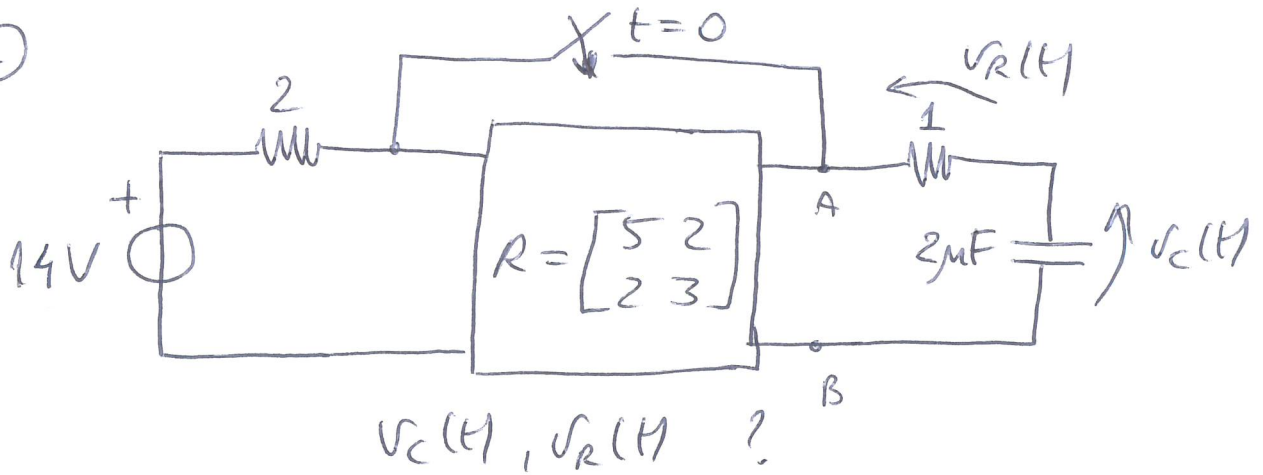
CIRCUITO RESISTIVO ASSOCIATO



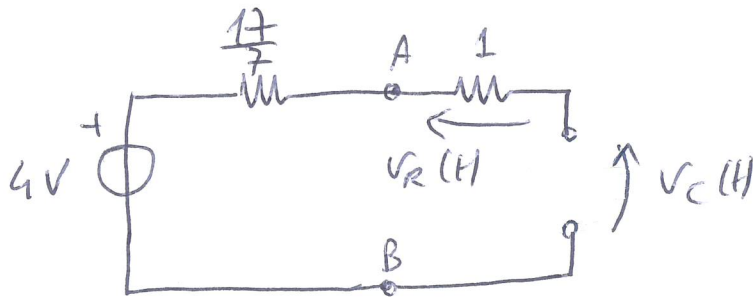
$$v_R(t) = \alpha_1 14 + \alpha_2 v_C(t)$$

TRANSITORI I ORDINE (TEMPO)

4) c)



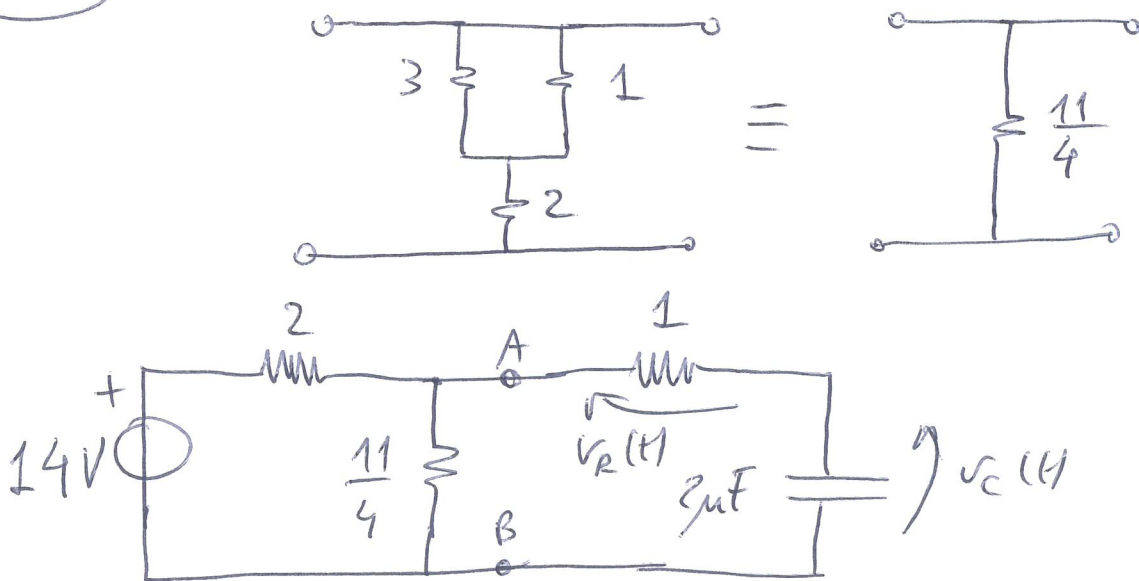
$t < 0$



$$v_R(t) = 0 \text{ V}$$

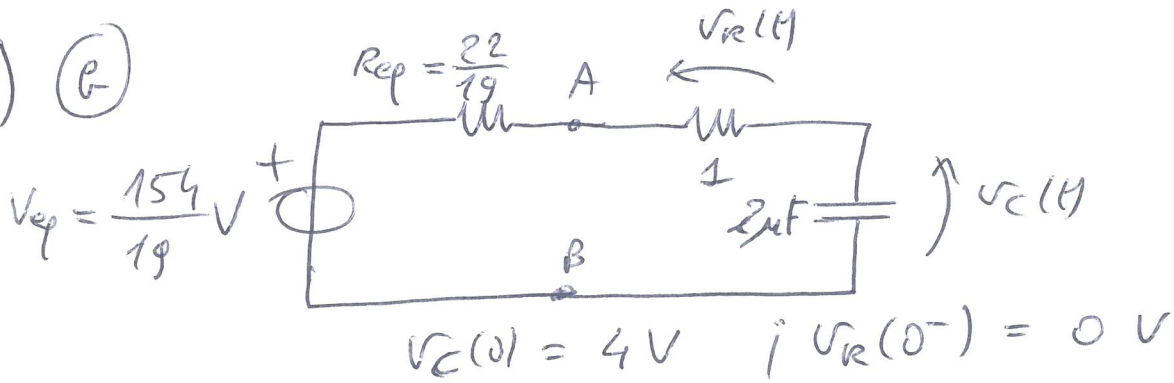
$$v_C(t) = 4 \text{ V}$$

$t \geq 0$



TRANSITORI I ORDINE (TEMPO)

4) (E)



$$v_C(t) = [V_0 - v_C^p(0)] e^{-t/\tau_c} + v_C^p(t)$$

$$V_0 = 4 \text{ V}$$

$$\tau_c = R_{eq} C = \left(\frac{22}{19} + 1 \right) \times 2 \times 10^{-6} = \frac{82}{19} \mu\text{s}$$

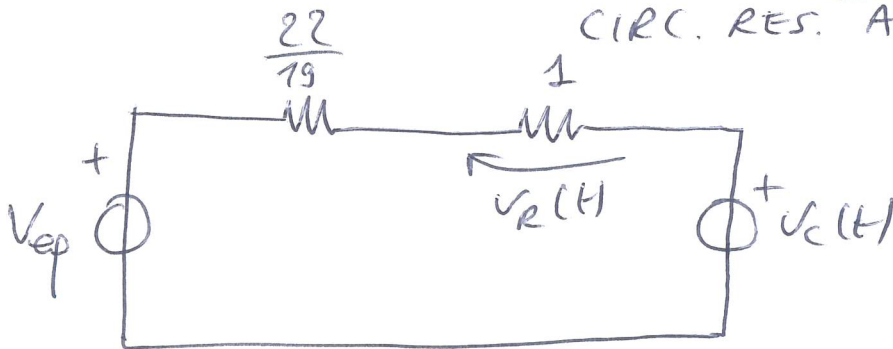
$$v_C^p(t) = \frac{154}{19} \text{ V}$$

$$v_C(t) = \left[4 - \frac{154}{19} \right] e^{-t/\tau_c} + \frac{154}{19} \text{ V}$$

$\underbrace{\hspace{10em}}_{-\frac{78}{19}}$

$$v_R(t) = 1 \times C \dot{v}_C(t) = [V_{eq} - v_C(t)] \frac{1}{1 + \frac{22}{19}} \text{ V}$$

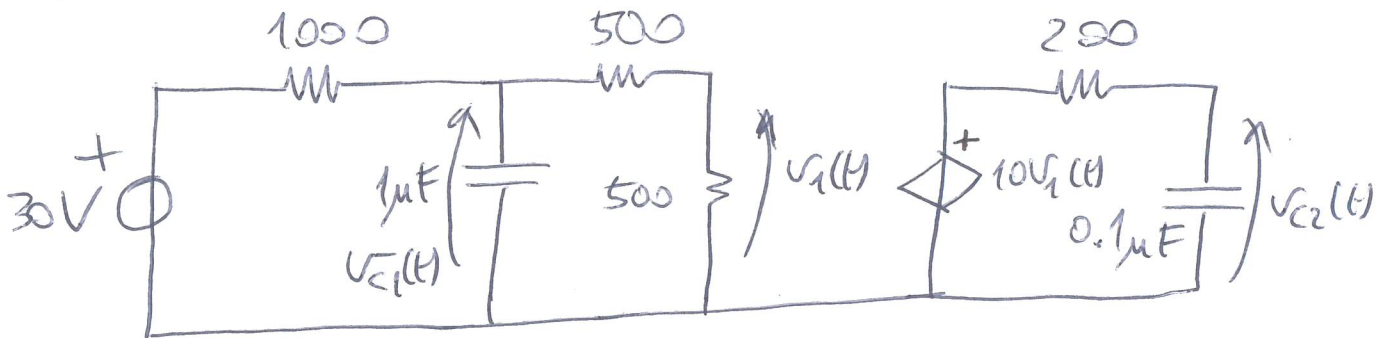
CIRC. RES. ASS.



$$v_R(0^+) = \left(\frac{154}{19} - 4 \right) \frac{19}{41} = \frac{78}{41} \text{ V}$$

TRANSITORI I ORDINE (TEMPO)

5) @

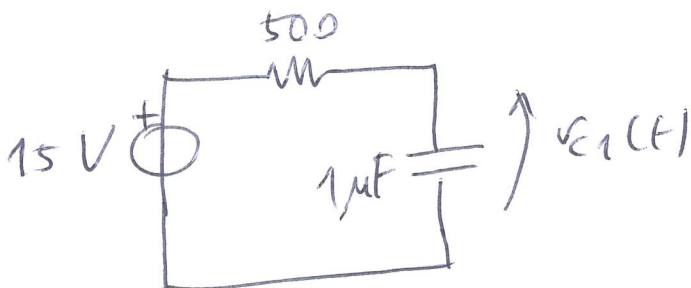


$$v_{c1}(0) = 10 \text{ V}$$

$$v_{c2}(0) = 5 \text{ V}$$

$v_{c1}(t), v_{c2}(t) ?$ per $t \geq 0$

$$v_1(t) = \frac{v_{c1}(t)}{2}$$



$$v_{c1}(t) = [10 - 15] e^{-t/\tau_{c1}} + 15 \text{ V}$$

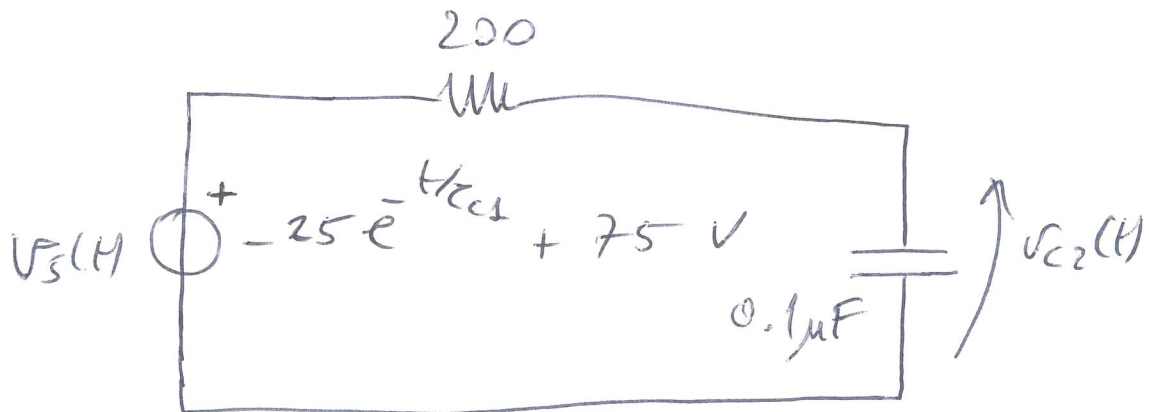
$t \geq 0$

$$\tau_{c1} = 500 \times 10^{-6} = 1 \times 10^{-4} \text{ s}$$

$$v_1(t) = -\frac{5}{2} e^{-t/\tau_{c1}} + \frac{15}{2} \text{ V}$$

TRANSITORI I ORDINE (TEMPO)

5) (2)



$$v_s(t) = \underbrace{-25 e^{-t/\tau_{c1}}}_{v_{s1}(t)} + \underbrace{75 V}_{v_{s2}(t)}$$

$$v_{c2}(t) = [V_{02} - v_c^p(0)] e^{-t/\tau_{c2}} + v_c^p(t)$$

$t > 0$

$$V_{02} = 5 V$$

$$\tau_{c2} = 200 \times 0.1 \times 10^{-6} = 20 \mu s$$

$$v_c^{p2}(t) = 75 V$$

$$\begin{cases} v_c^{p1}(t) = -\frac{v_c^{p1}(t)}{\tau_{c2}} + \frac{v_{s1}(t)}{\tau_{c2}} \\ v_c^{p1}(t) = V_p e^{-t/\tau_{c1}} \end{cases}$$

$$-\frac{V_p}{\tau_{c1}} e^{-t/\tau_{c1}} = -\frac{V_p}{\tau_{c2}} e^{-t/\tau_{c1}} + \frac{(-25) e^{-t/\tau_{c1}}}{\tau_{c2}}$$

$$V_p = \frac{-25}{\tau_{c2} \left(\frac{1}{\tau_{c2}} - \frac{1}{\tau_{c1}} \right)} = \frac{-25}{1 - 0.2} = -31.25 V$$

TRANSITORI I ORDINE (TEMPO)

5) c)

$$v_c^p(t) = 75 - 31.25 e^{-t/\tau_{c1}} \quad V$$

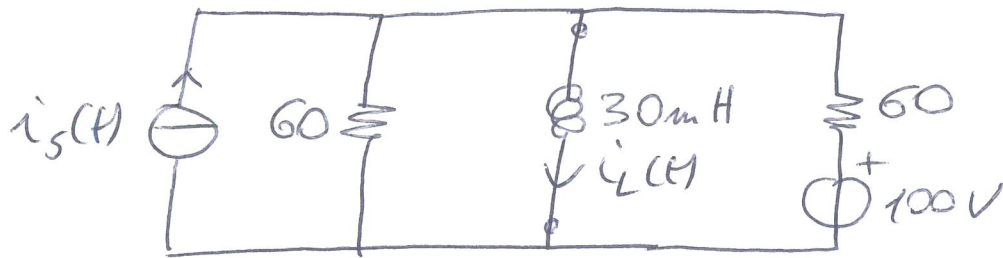
$$v_c^p(0) = 75 - 31.25 = 43.75 \quad V$$

$$v_c(t) = \underbrace{[5 - 43.75]}_{-38.75} e^{-t/\tau_{c2}} + 75 - 31.25 e^{-t/\tau_{c1}} \quad V$$

$t \gg 0$

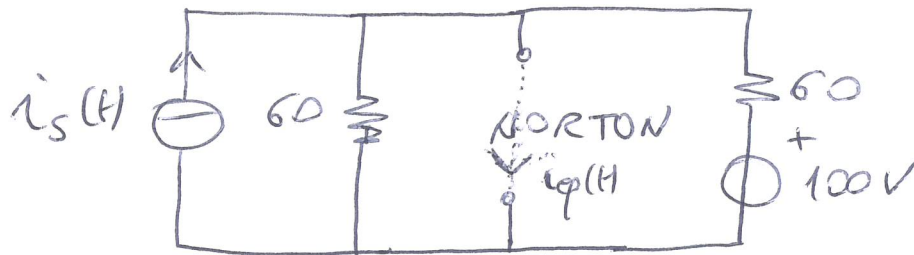
TRANSITORI I ORDINE (TEMPO)

q) a)



$$i_s(t) = 10 \cos(1000t) \text{ A}$$

$$i_L(0) = -1 \text{ A}$$



$$R_{eq} = 60 \parallel 60 = 30 \Omega$$

$$i_{ep}(t) = \underbrace{i_s'(t)}_{i_s(t)} + \underbrace{i_{ep}''(t)}_{V_s}$$

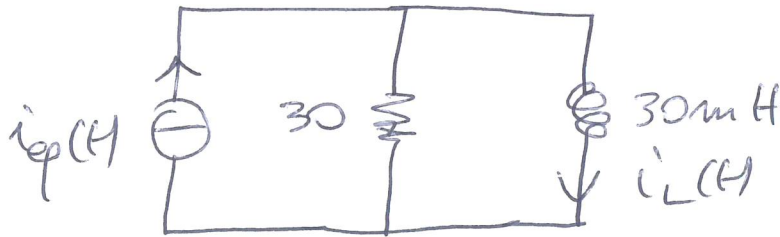
$$i_{ep}'(t) = i_s(t) = 10 \cos(1000t) \text{ A}$$

$$i_{ep}''(t) = \frac{100}{60} = \frac{5}{3} \text{ A}$$

$$i_{ep}(t) = \frac{5}{3} + 10 \cos(1000t) \text{ A}$$

TRANSITORI I ORDINE (TEMPO)

a) (2)



$$i_{ep}(t) = \frac{5}{3} + 10 \cos(10000t) \text{ A}$$

$$i_L(0) = -1 \text{ A}$$

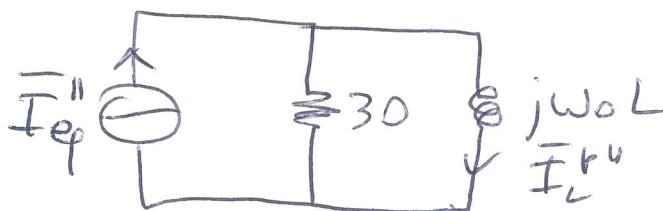
$$i_L(t) = [I_0 - i_L^p(0)] e^{-t/\tau_L} + i_L^p(t) \quad t \geq 0$$

$$I_0 = i_L(0) = -1 \text{ A}$$

$$\tau_L = G_{ep} L = \frac{30 \cdot 10^{-3}}{30} = 1 \text{ ms}$$

$$i_L^p(t) = i_L^{p1}(t) + i_L^{p2}(t)$$

$$i_L^{p1}(t) = \frac{5}{3} \text{ A}$$



$$I_{ep}'' = 10 \text{ A}$$

$$I_L^{p2} = \frac{30}{30 + j\omega L} I_{ep}'' =$$

$$= \frac{30}{30 + j30} 10 = \frac{10}{1 + j}$$

$$|I_L^{p2}| = \frac{10}{\sqrt{2}} \text{ A} \quad \angle I_L^{p2} = -\frac{\pi}{4} + 2k\pi \text{ rad}$$

TRANSITORI I ORDINE (TEAPO)

$$b) \textcircled{c} \quad i_L^{pu}(t) = \frac{10}{\sqrt{2}} \cos\left(1000t - \frac{\pi}{4}\right) \text{ A}$$

$$i_L^p(t) = \frac{5}{3} + \frac{10}{\sqrt{2}} \cos\left(1000t - \frac{\pi}{4}\right) \text{ A}$$

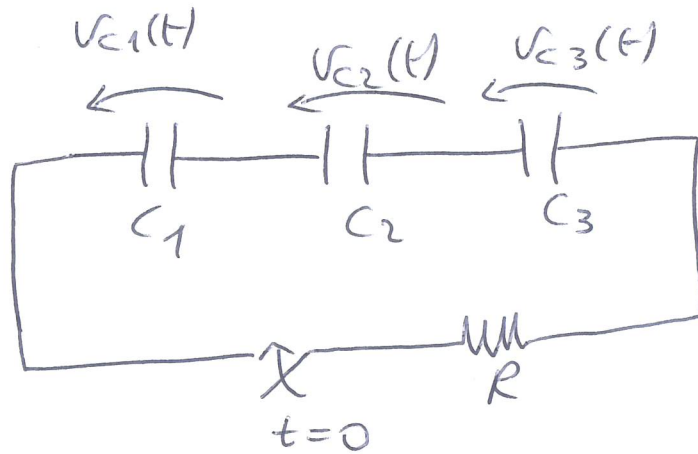
$$i_L^p(0) = \frac{5}{3} + \frac{10}{2} = \frac{20}{3} \text{ A}$$

$$i_L(t) = \underbrace{\left[-1 - \frac{20}{3}\right]}_{-\frac{23}{3}} e^{-t/\tau_L} + \frac{5}{3} + \frac{10}{\sqrt{2}} \cos\left(1000t - \frac{\pi}{4}\right) \text{ A}$$

$t \geq 0$

TRANSITORI I ORDINE (TEMPO)

11)



$$v_{C1}(0), v_{C2}(0), v_{C3}(0) \quad \text{NOTI}$$

$$v_{C1}^{\infty}, v_{C2}^{\infty}, v_{C3}^{\infty} \quad ?$$

$$v_{C1}^{\infty} + v_{C2}^{\infty} + v_{C3}^{\infty} = 0$$

$$\underbrace{C_1 [v_{C1}^{\infty} - v_{C1}(0)]}_{\Delta Q_1} = \underbrace{C_2 [v_{C2}^{\infty} - v_{C2}(0)]}_{\Delta Q_2} = \underbrace{C_3 [v_{C3}^{\infty} - v_{C3}(0)]}_{\Delta Q_3}$$

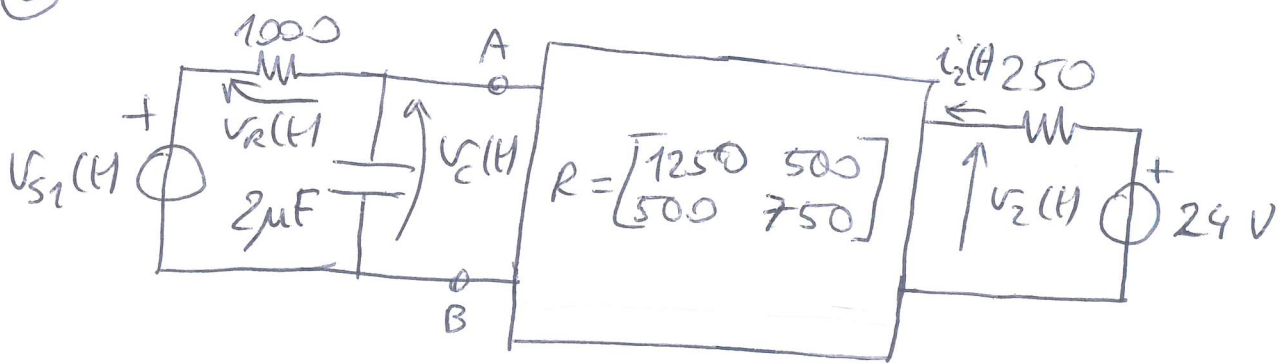
$$\begin{cases} v_1 + v_2 + v_3 = 0 \\ v_1 - 2v_2 = -1 \\ -2v_2 + 0.5v_3 = -3.5 \end{cases} \quad \begin{cases} C_1 = 1F \quad v_{10} = 1V \\ C_2 = 2F \quad v_{20} = 1V \\ C_3 = 0.5F \quad v_{30} = -3V \end{cases}$$

$$v_{C1}^{\infty} = 1.2857V; v_{C2}^{\infty} = 1.1429V; v_{C3}^{\infty} = -2.4286V$$

$$\Delta Q_1 = \Delta Q_2 = \Delta Q_3 = 0.2857 \times 10^{-6} C$$

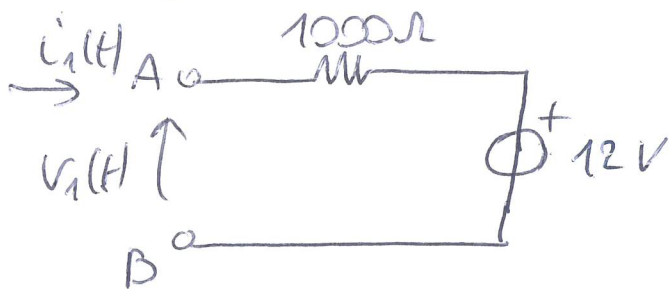
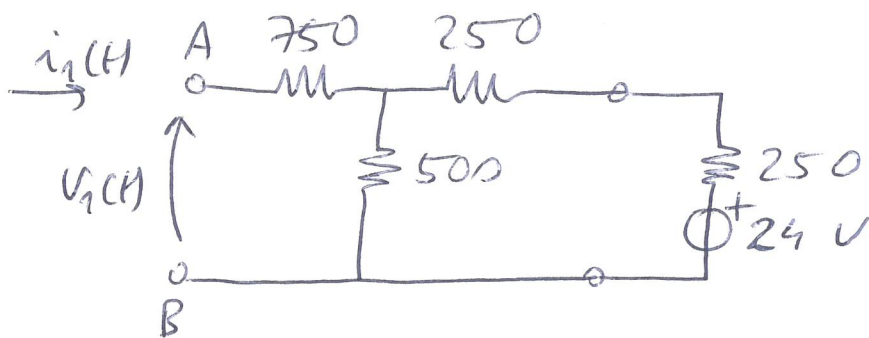
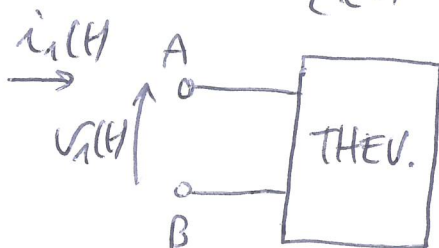
TRANSITORI I ORDINE (TEAPO)

14) ②



$$v_{S1}(t) = 10 \cos(1000t) \text{ V}$$

$$v_c(0) = -1 \text{ V}$$

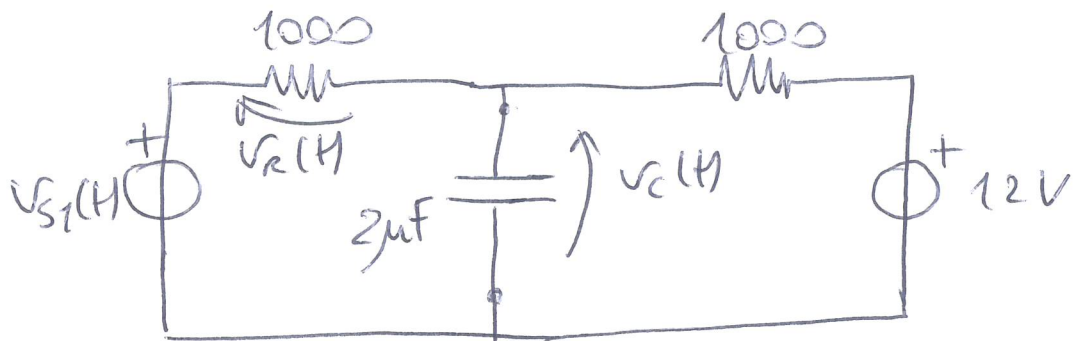


$$\begin{cases} v_1(t) = 1250 i_1(t) + 500 i_2(t) \\ v_2(t) = 500 i_1(t) + 750 i_2(t) \\ v_2(t) = -250 i_2(t) + 24 \end{cases}$$

$$v_1(t) = 1000 i_1(t) + 12$$

TRANSITORI I ORDINE (TEMPO)

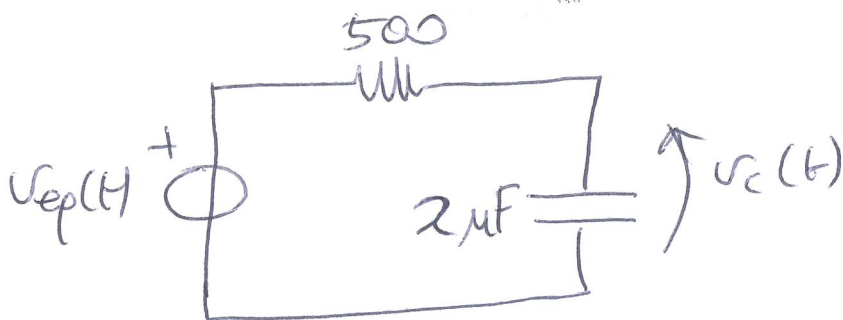
14) (2)



$$v_{S1}(t) = 10 \cos(1000t) \text{ V}$$

$$v_C(0) = -1 \text{ V}$$

$$v_R(t) = v_{S1}(t) - v_C(t)$$



$$v_{ep}(t) = \frac{\frac{v_{S1}(t)}{1000} + \frac{12}{1000}}{\frac{1}{1000} + \frac{1}{1000}} = \frac{v_{S1}(t) + 12}{1000} \cdot \frac{1000}{2} =$$

$$= \frac{v_{S1}(t)}{2} + 6 = 5 \cos(1000t) + 6 \text{ V}$$

TRANSITORI I ORDINE (TEMPO)

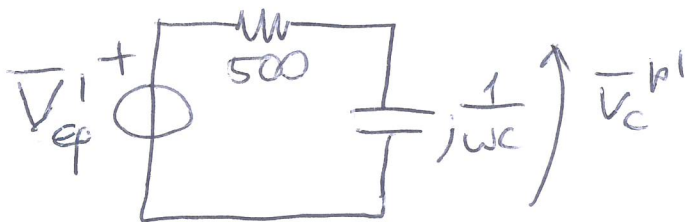
14) ©

$$v_c(t) = [V_0 - v_c^p(0)] e^{-t/\tau_c} + v_c^p(t)$$

$$V_0 = -1V$$

$$\tau_c = R_{eq} C = 500 \times 2 \times 10^{-6} = 1ms$$

$$v_c^p(t) = \underbrace{v_c^{p1}(t)}_{\cos} + \underbrace{v_c^{p2}(t)}_{\text{cost.}}$$



$$\bar{V}_{eq}^1 = 5V$$

$$\bar{v}_c^{p1} = \frac{\frac{1}{j\omega C}}{500 + \frac{1}{j\omega C}} \bar{V}_{ep}^1 = \frac{5}{1+j} V$$

$$|\bar{v}_c^{p1}| = \frac{5}{\sqrt{2}} V \quad \angle \bar{v}_c^{p1} = -\frac{\pi}{4} + 2k\pi \text{ rad}$$

$$v_c^{p1}(t) = \frac{5}{\sqrt{2}} \cos(1000t - \frac{\pi}{4}) V$$

$$v_c^{p1}(0) = \frac{5}{2} V$$

$$v_c^{p2}(t) = 6V$$

$$v_c^p(t) = 6 + \frac{5}{\sqrt{2}} \cos(1000t - \frac{\pi}{4}) V$$

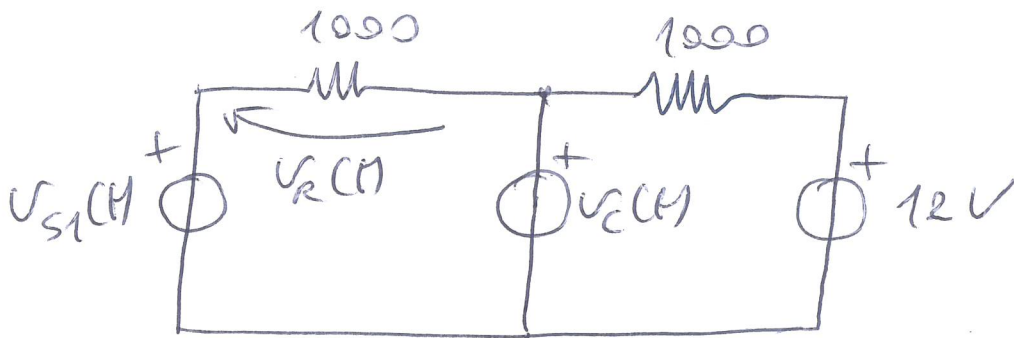
TRANSITORI I ORDINE (TEMPO)

14) d)

$$v_C(t) = \underbrace{\left[-1 - \frac{5}{2} - 6\right]}_{-9.5} e^{-t/\tau_c} + 6 + \frac{5}{\sqrt{2}} \cos\left(1000t - \frac{\pi}{4}\right) \text{ V}$$

$t \geq 0$

CIRC. RES. ASS.

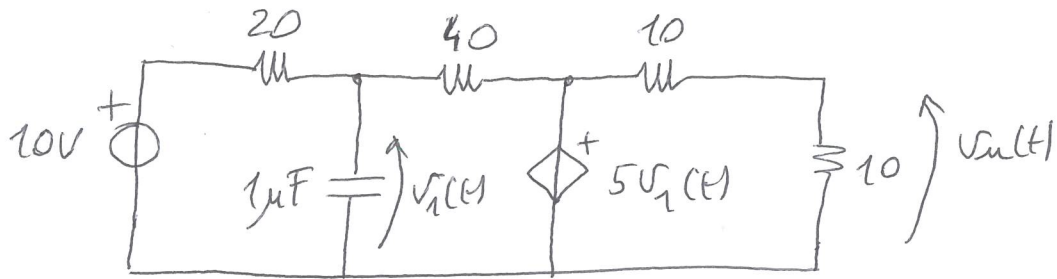


$$v_R(t) = v_{S1}(t) - v_C(t)$$

$$v_R(0) = v_{S1}(0) - v_C(0) = 10 - (-1) = 11 \text{ V}$$

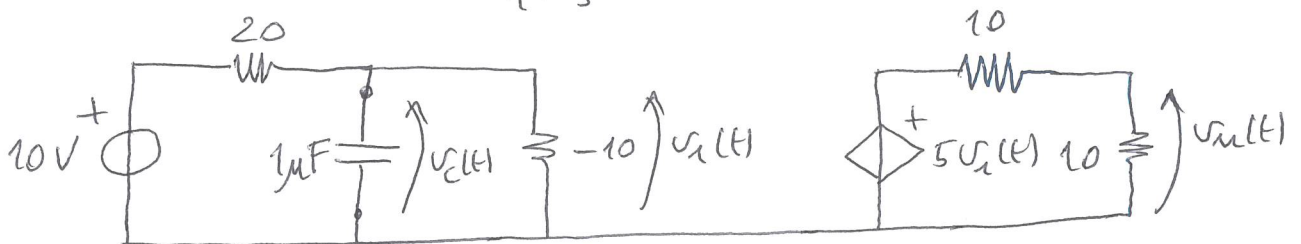
TRANSITORI I ORDINE (TEMPO)

15)



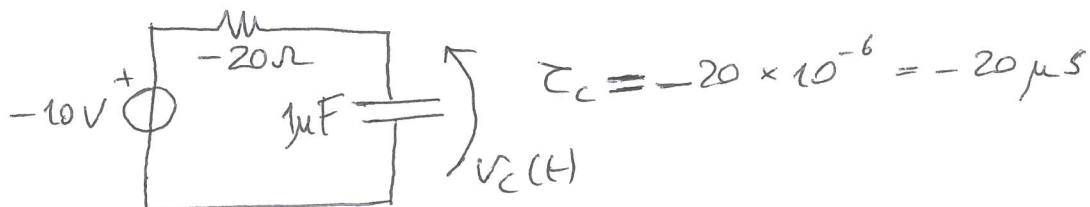
$$u_c(0) = 1 \text{ V}$$

$$\text{MILLER I: } R_c = \frac{40}{1-5} = -10 \Omega$$



$$R_{eq} = 20 \parallel (-10) = \frac{20 \times (-10)}{20 - 10} = -20 \Omega$$

$$V_{eq} = \frac{-10}{20 - 10} 10 = -10 \text{ V}$$



$$\tau_c = -20 \times 10^{-6} = -20 \mu\text{s}$$

$$u_c(t) = (1 - (-10)) e^{-\frac{t}{\tau_c}} + (-10) \text{ V}$$

\uparrow
 INSTABILE

$$u_u(t) = \frac{5}{2} u_c(t)$$