$\therefore$ The voltage across 0.96 Ω = voltage across resistors $a, b, c, d = V_1$

$= 6.75 \times 0.96 = 6.5$ V

The voltage across f and g $= 20 - 6.5 = 13.5$ V

$$P = \frac{V^2}{R}$$

$$\therefore \quad P_a = \frac{6.5^2}{2} = 21.1 \text{ W}, \; P_b = \frac{6.5^2}{4} = 10.6 \text{ W}$$

$$P_c = \frac{6.5^2}{6} = 7.05 \text{ W}, \; P_d = \frac{6.5^2}{8} = 5.34 \text{ W}$$

$$P_f = \frac{13.5^2}{3} = 60.7 \text{ W}, \; P_g = \frac{13.5^2}{8} = 30.3 \text{ W}$$

$$P_d = \frac{20^2}{5} = 80 \text{ W}$$

To halve the current, the total resistance should be doubled. Hence the resistance to be added in sereis

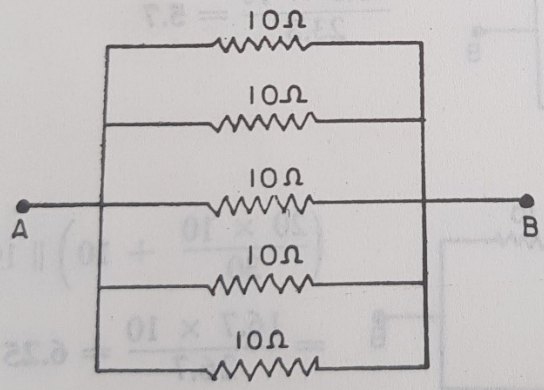
$$R_{AB} = \mathbf{1.86\ \Omega}$$

Problem 5.45 A laboratory variable resistor has five 10 Ω elements, which can be joined in series, parallel or series-parallel in any way desired. Find what combinations are possible when all five elements are used, and state the resistance in each case.

[2, 2.86. 3.75, 4.29, 5, 5.7, 6.25, 7.14, 8, 8.33, 8.57, 12, 12.5, 14, 16, 17.5, 20, 23.3, 26.7, 35, 50 Ω]

Solution

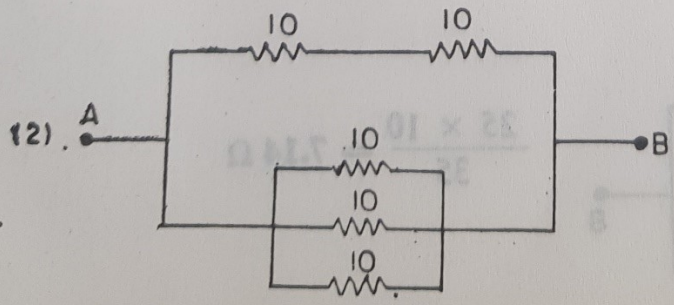
1.



All five in parallel $= R = \frac{10}{5}$

$= 2\ \Omega$

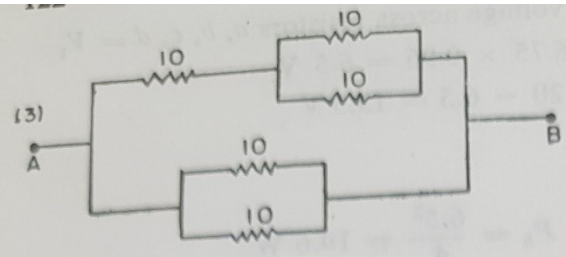
(2)



$$20 \| 1 \quad \frac{10}{3} = \frac{20 \times 13/3}{20 + 10/3}$$

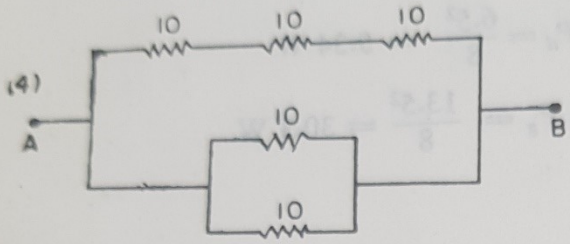
$$= \frac{20 \times 10}{70} = 2.86\ \Omega$$

(3)



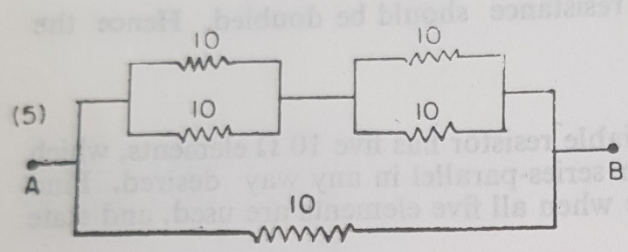
$$15\|15 = \frac{15 \times 5}{20} = 3.75\ \Omega$$

(4)



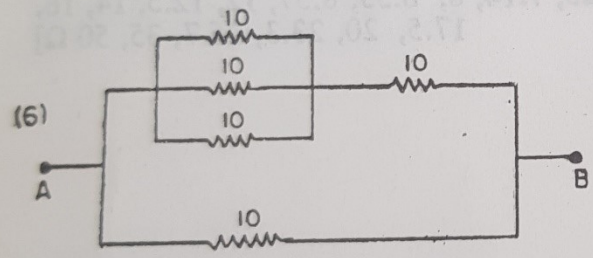
$$30\|15 = \frac{30 \times 5}{35} = 4.29\ \Omega$$

(5)



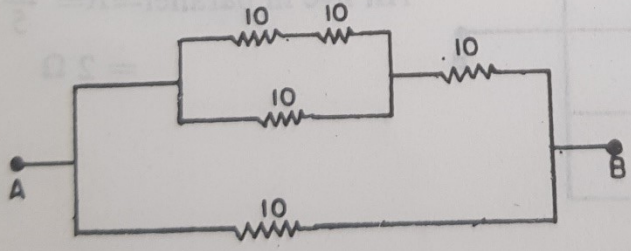
$$10\|10 = 5\Omega$$

(6)



$$\frac{13.3 \times 10}{23.3} = 5.7$$

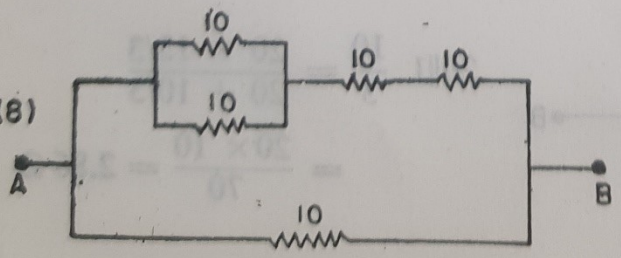
7.



$$\left(\frac{20 \times 10}{30} + 10\right) \| 10$$

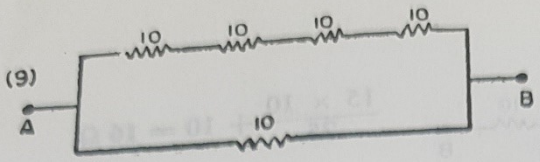
$$= \frac{16.7 \times 10}{26.7} = 6.25$$

(8)



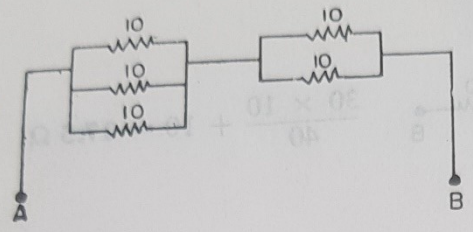
$$\frac{25 \times 10}{35} = 7.14\ \Omega$$

(9)



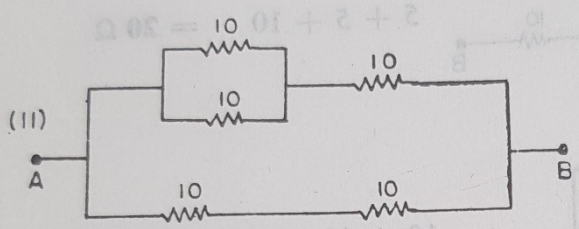
$$\frac{40 \times 10}{50} = 8\ \Omega$$

(10)



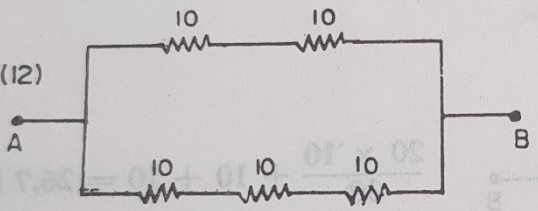
$$3.33 + 5 = 8.33\ \Omega$$

(11)



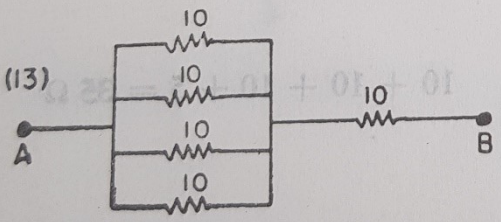
$$\frac{20 \times 15}{35} = 8.57\ \Omega$$

(12)



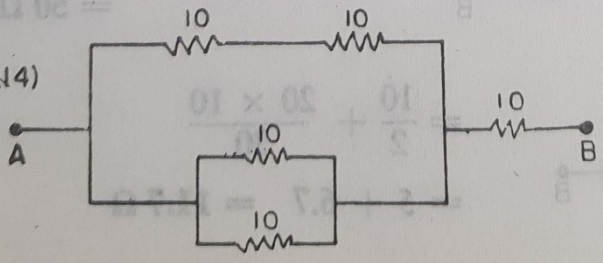
$$\frac{20 \times 30}{50} = 12\ \Omega$$

(13)



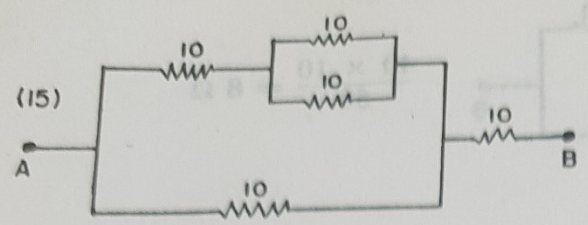
$$2.5 + 10 = 12.5\ \Omega$$

(14)



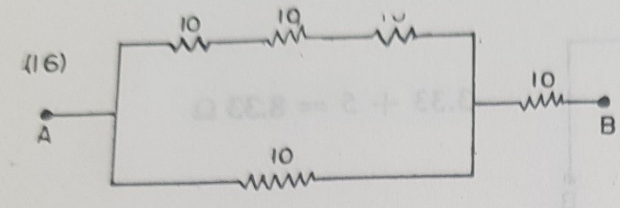
$$\frac{20 \times 5}{25} + 10 = 14\ \Omega$$

(15)



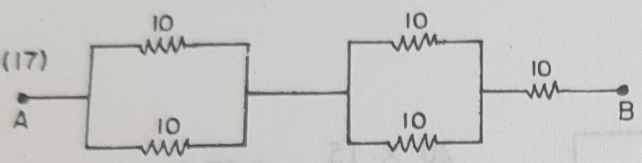
$$\frac{15 \times 10}{25} + 10 = 16\ \Omega$$

(16)



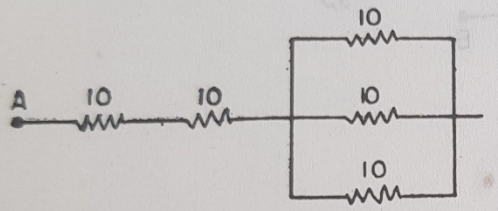
$$\frac{30 \times 10}{40} + 10 = 17.5\ \Omega$$

(17)



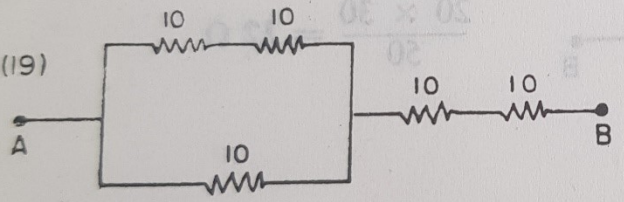
$$5 + 5 + 10 \quad = 20\ \Omega$$

(18)

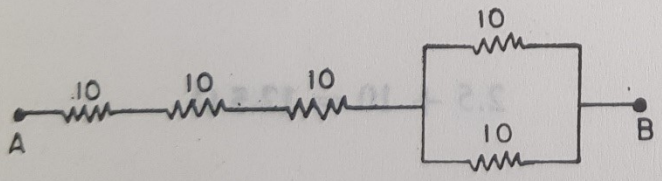


$$10 + 10 + 3.3 = 23.3\ \Omega$$

(19)

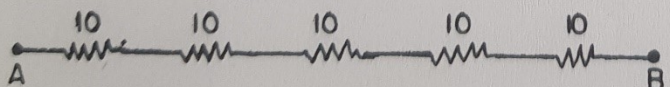


$$\frac{20 \times 10}{30} + 10 + 10 = 26.7\ \Omega$$



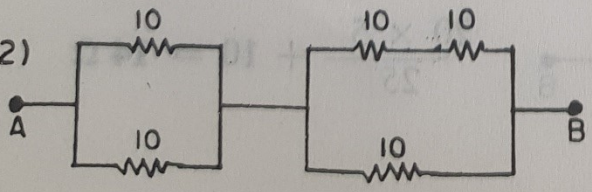
$$10 + 10 + 10 + 5 = 35\ \Omega$$

(21)



$$10 + 10 + 10 + 10 + 10 = 50\ \Omega$$

(22)

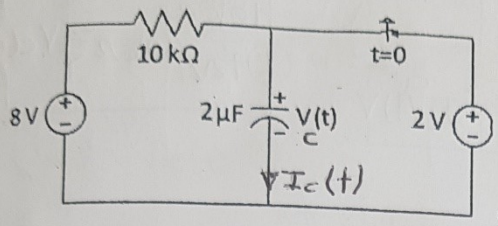


$$= \frac{10}{2} + \frac{20 \times 10}{30}$$

$$= 5 + 6.7 \quad = 11.7\ \Omega$$

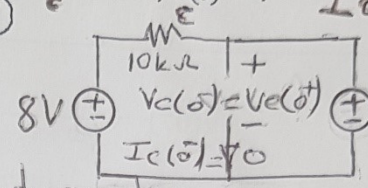
I - t'de DEVRE ÇÖZÜMÜ

1)



Anahtar t = 0 anında açılıyor.

$v_c(0^-) = ?$, $v(t) = ?$ $I_c(t) = ?$



Çözüm:

$v_c(0^-) = 2\ V = V_c(0^+)$

2. durumda Zaman sabiti (τ) = $R_{eş} \cdot C$

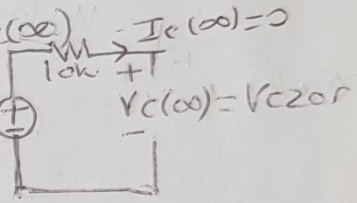
gerilim kaynağı, kısa devre

$\tau = RC = 10^4 \cdot 2 \cdot 10^{-6} = 0{,}02\ s$

$v_{c_{öz}} = A \cdot e^{-\frac{t}{RC}}$ $_{eş}$

$v_{c_{öz}} = A \cdot e^{-50t}$ $Vc(t) = Ae^{\frac{t}{\tau}} + Vc(\infty)$

$v_{zor} = 8\ V = Vc(\infty)$



$v_c(t) = A \cdot e^{-50t} + 8$

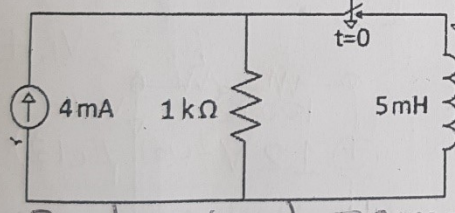
$v_c(0^+) = A + 8 = 2$

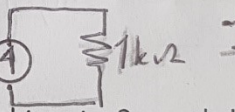
$A = -6$

$v_c(t) = [-6 \cdot e^{-50t} + 8]\ u(t)\ V$

$I_c(t) = C \cdot \frac{dVc(t)}{dt} = 2 \times 10^{-6} \left[-6 \cdot (-50) \cdot e^{-50t}\right]$

2)



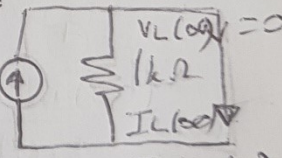


$I_L(0^-) = 0 = I_L(0^+)$

Anahtar t = 0 anında kapanıyor.

$V_L(t) = ?$

$i(0) = 0 = I_L(0^+)$ $i(t) = ?$



2. durumda Zaman sabiti

Akım kaynağı, açık devre

Çözüm:

$\tau = \frac{L}{R_{eş}}$ $\tau = \frac{1}{r}$

$r = \frac{R_{eş}}{L} = \frac{1000}{5 \cdot 10^{-3}} = 2 \cdot 10^5\ \frac{1}{s}$

$i_{L_{öz}} = A \cdot e^{-\frac{R_{eş}}{L}t}$

$i_{L_{öz}} = A \cdot e^{-2 \cdot 10^5 t}$

$I_L(t) = A e^{\frac{-t}{\tau}} + I_L(\infty)$

$i_{L_{zor}} = 4\ mA$

$i_L(t) = 4 + A \cdot e^{-2 \cdot 10^5 t}$

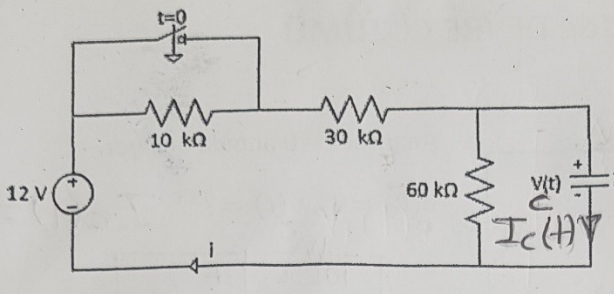
$i_L(0^+) = 4 + A = 0$

$A = -4$

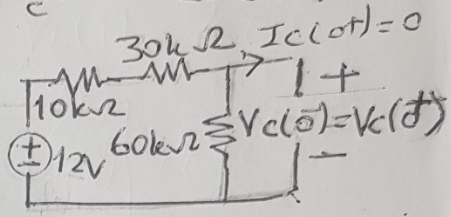
$i_L(t) = [4 - 4 \cdot e^{-2 \cdot 10^5 t}]\ u(t)\ \ mA$

$V_L(t) = L \cdot \frac{di_L(t)}{dt} = 5 \times 10^{-3} \cdot \left[-4 \cdot (-2 \times 10^5 e^{-2 \times 10^5 t})\right]$

3)



$v(t) = ?$ $I_C(t) = ?$



Çözüm:

$$i(0^-) = \frac{12}{(10+30+60)10^3} = 0{,}12\ mA$$

$$v_C(0^-) = 0{,}12 \cdot 60 = 7{,}2\ V = V_C(0^+)$$

$$i(\infty) = \frac{12}{(60+30)10^3} = 0{,}133\ mA \qquad v(\infty) = \frac{12}{90} \cdot 60 = 8\ V = V_{C\infty}$$

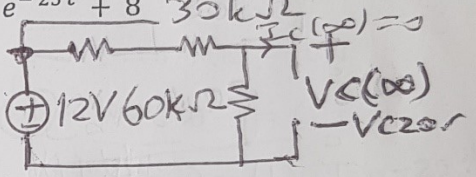
Zaman sabiti 2 du umda

$$v_{öz} = A \cdot e^{-\frac{t}{RC_{Eş}}} \qquad \tau = RC_{Eş} = \left(\frac{60 \cdot 30}{90}\right) \cdot 10^3 \cdot 2 \cdot 10^{-6} = 40 \cdot 10^{-3}\ \frac{1}{s}$$

$$v_{öz} = A \cdot e^{-25t} \qquad v_C(t) = A \cdot e^{-25t} + 8$$

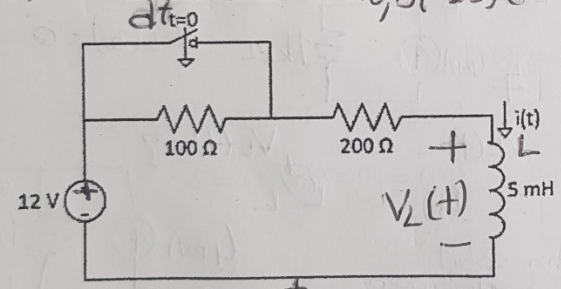
$$v_C(0^+) = 7{,}2 = A + 8 \qquad A = -0{,}8$$

$$v_C(t) = [8 - 0{,}8 \cdot e^{-25t}]\ u(t)\ \ V$$

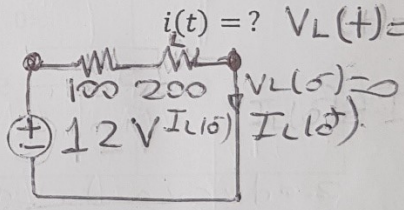


$$I_C(t) = C \cdot \frac{dv_C(t)}{dt} = 2 \times 10^{-6} \times 0{,}8(-25)e^{-25t}$$

4)



$i(t) = ?$ $V_L(t) = ?$

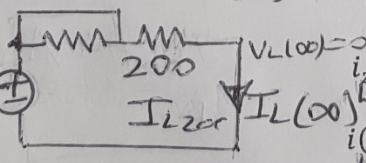


$$I_L(t) = A \cdot e^{-\frac{t}{\tau}} + I_L(\infty) \qquad \tau = \frac{L}{R_{Eş}}$$ ikinci durumda

Çözüm:

$$i_L(0^-) = \frac{12}{300} = 0{,}04\ A = 40\ mA = I_L(0^+) \qquad \tau = \frac{L}{R_{Eş}} = \frac{200}{5 \cdot 10^{-3}} = 40000\ \frac{1}{s} \qquad \tau = \frac{1}{r}$$

$$i_{öz} = A \cdot e^{-\frac{R}{L}t}$$



$$i_{zor} = \frac{12}{200} = 0{,}06\ A = 60\ mA$$

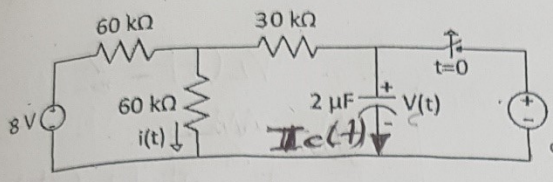
$$i_{öz} = A \cdot e^{-40000t} \qquad i_L(0^+) = A + 60 = 40$$

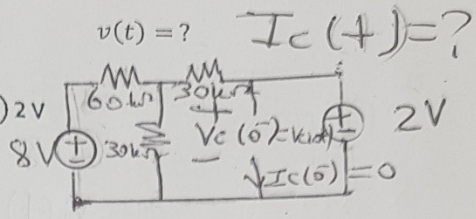
$$i_L(t) = A \cdot e^{-40000t} + 60 \qquad A = -20$$

$$i_L(t) = [60 - 20 \cdot e^{-40000t}]\ u(t)\ \ A$$

$$V_L(t) = L \cdot \frac{di_L(t)}{dt} = 5 \times 10^{-3}\left[-20 \cdot (-40000)e^{-40000t}\right]$$

5)





Çözüm:

$v_c(0^-) = 2\ V = Vc(0^+)$

$v_{öz} = A \cdot e^{-\frac{t}{RC}}$

$v_{öz} = A \cdot e^{-\frac{t}{0,12}}$

$Vc(t) = A\,e^{-\frac{t}{\tau}} + Vc(\infty)$

$v_c(t) = v_{zor} + A \cdot e^{-\frac{t}{0,12}}$

$v_c(t) = 4 + A \cdot e^{-\frac{t}{0,12}}$

$v_c(t) = \left[4 - 2 \cdot e^{-\frac{t}{0,12}}\right] u(t)\ V$

$R_{eş} = \frac{60 \cdot 60}{60 + 60} + 30 = 60\ k\Omega$

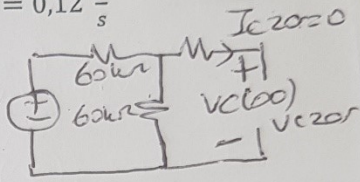
2 durumda

$\tau = R_{eş} C = 60 \cdot 10^3 \cdot 2 \cdot 10^{-6} = 0,12\ \frac{1}{s}$

$i(\infty) = \frac{8}{120} = 0,066\ mA$

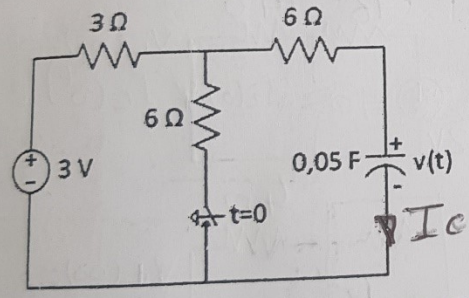
$v_c(\infty) = 0,066 \cdot 60 = 4\ V$

$v_c(0^+) = 4 + A = 2\ ,\quad A = -2$



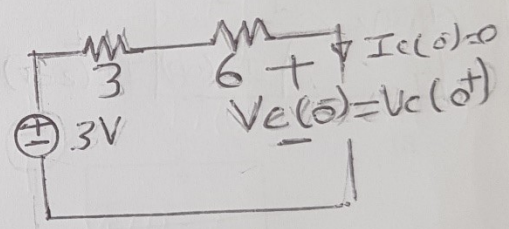
$I_c(t) = C\frac{Vc(t)}{dt} = 2 \times 10^{-6}\left[\left(-\frac{1}{0,12}\right) e^{-\frac{t}{0,12}}\right]$

6)



$v_c(t) = ?$

$I_c(t)$



Çözüm: $v_c(0^-) = 3\ V = Vc(0^+)$

$\tau = R_{eş} \cdot C = 8 \times 0,05 = 0,4$

$v_{öz} = A \cdot e^{-\frac{t}{RC}} = A \cdot e^{-\frac{t}{0,4}}$

$R_{eş} = \frac{3 \cdot 6}{9} + 6 = 8\ \Omega$

$v_{öz} = A \cdot e^{-2,5t}$

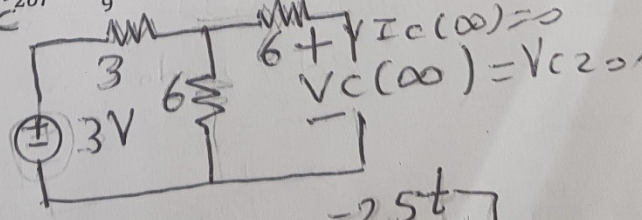
$Vc(t) = A\,e^{-\frac{t}{\tau}} + Vc2or$

$v_c(t) = 2 + A \cdot e^{-2,5t}$

$v_c(0^+) = 2 + A = 3 \qquad A = 1$

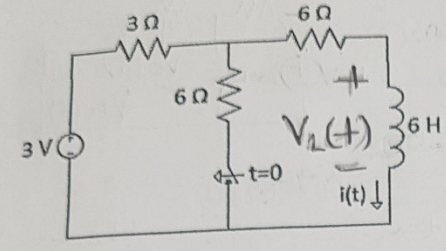
$v_c(t) = [2 + e^{-2,5t}]\ u(t)\ V$

$v_{zor} = \frac{3}{9} \cdot 6 = 2\ V = Vc(\infty)$

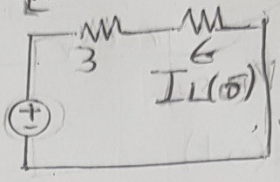


$I_c(t) = C \cdot \frac{dVc(t)}{dt} = 0,5 \cdot \left[-2,5\, e^{-2,5t}\right]$

7)



$i(t) = ?$ $V_L(t) = ?$



$I_L(0^+)$

$V_L(0^-) = 0$

Çözüm:

$$i(0^-) = \frac{3}{3+6} = \frac{1}{3}\ A = I_L(0^+) \qquad \tau = \frac{L}{Res}$$

$$R_{es} = \frac{3\cdot 6}{9} + 6 = 8\ \Omega \qquad \tau = \frac{L}{Res} = \frac{8}{6} = 1{,}33\ \left(\frac{1}{s}\right)$$

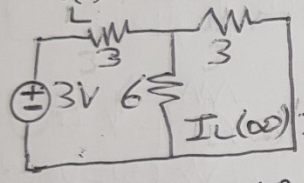
$$i_{öz} = A \cdot e^{-\frac{R}{L}\cdot t} \qquad i_{öz} = A \cdot e^{-1{,}33\,t}$$

$$I_L(t) = A \cdot e^{-\frac{t}{\tau}} + I_L(\infty)$$

$$i_{zor} = \frac{3}{3+3}\cdot\frac{1}{2} = 0{,}25\ A$$

$$i(t) = 0{,}25 + A \cdot e^{-1{,}33\,t}$$

$$i(0^+) = \frac{1}{3} = \frac{1}{4} + A \qquad A = \frac{1}{12}$$

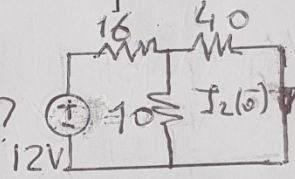


$I_L(zor)$

$$i(t) = \left[\frac{1}{4} + \frac{1}{12}\cdot e^{-1{,}33\,t}\right] u(t)\ A$$

$I_L(t) = ?$

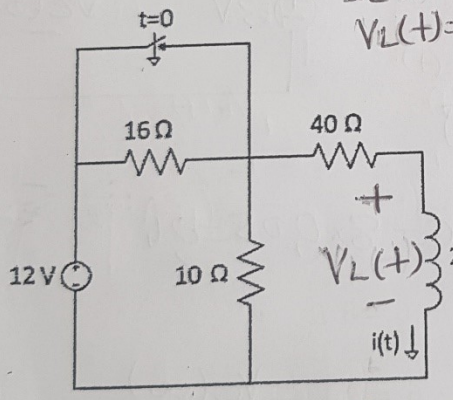
$V_L(t) = ?$

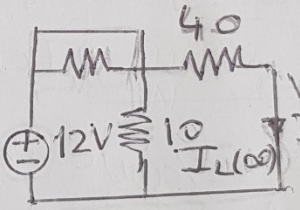


$V_L(0^-) = 0$

$I_L(0^+)$

8)





$V_L(\infty) = 0$

I_{Lzor}

Çözüm:

$$i(0^-) = \frac{12}{16 + \frac{40\cdot 10}{50}}\cdot\frac{1}{5} = 0{,}1\ A = I_L(0^+)$$

2 durumda

$$\tau = \frac{L}{Res}$$

$$i_{öz} = A \cdot e^{-\frac{R}{L}t} \qquad \tau = \frac{Res}{L} = \frac{40}{20} = 2\ \frac{1}{s}$$

$$i_{öz} = A \cdot e^{-2t}$$

$$I_L(t) = A\,e^{-\frac{t}{\tau}} + I_L(\infty)$$

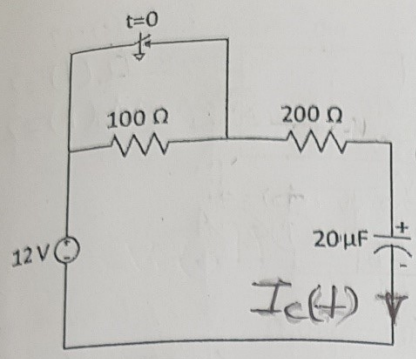
$$i_{zor} = \frac{12}{\frac{40\cdot 10}{50}}\cdot\frac{1}{5} = 0{,}3\ A$$

$$i(t) = A \cdot e^{-2t} + 0{,}3$$

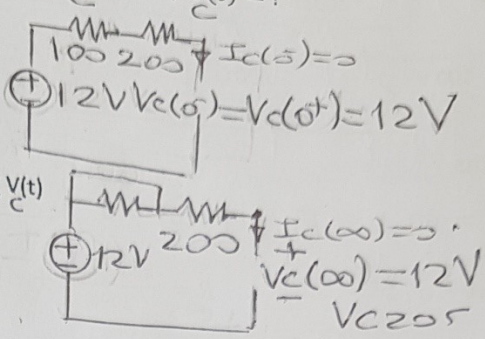
$$i(0^+) = A + 0{,}3 = 0{,}1 \qquad A = -0{,}2 \qquad i(t) = [0{,}3 - 0{,}2 \cdot e^{-2t}]\,u(t)\ A$$

$$V_L(t) = L\cdot\frac{di_L(t)}{dt} = 20\cdot\left[(-0{,}2)(-2)\cdot e^{-2t}\right]$$

9)



$v_c(0) = ?$; $v_c(t) = ?$



Çözüm:

$v_c(0) = 12\ V = V_c(0^+)$

Öz çözüm için; $\frac{1}{R_{es} \cdot C} = \frac{10^6}{200 \cdot 20} = 2500\ \frac{1}{s} = r$

2. durum $v_{zor} = 12\ V$

$\tau = \frac{L}{R_{es}}$

$r = -\frac{1}{\tau}$

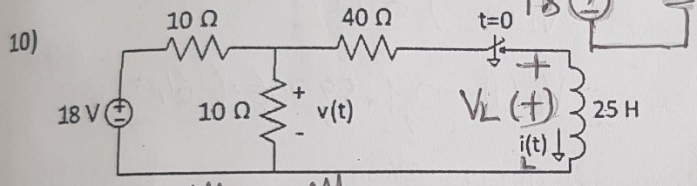
$v_{öz} = A \cdot e^{-2500\,t}$

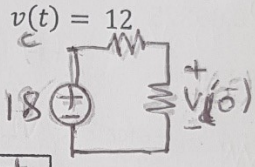
$v_c(t) = A \cdot e^{-\frac{t}{\tau}} + V_c(\infty)$

$v_c(t) = A \cdot e^{-2500\,t} + 12$

$v_c(0^+) = A + 12 = 12 \qquad A = 0$

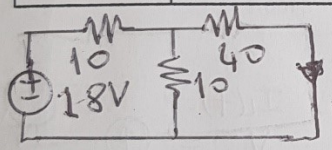
10)





$v(t) = ?$ $I_L(t) = ?$ $V_L(t) = ?$

$i(0^-) = 0 = I_L(0^+)$



$r = -\frac{1}{\tau}$

$\tau = \frac{L}{R_{es}}$

Çözüm:

$v(0^-) = 9\ V$

$i(0) = 0$

$i_{öz} = A \cdot e^{-\frac{R}{L}t}$

$R_{es} = \frac{10 \cdot 10}{20} + 40 = 45\ \Omega$ $r = -\frac{R_{es}}{L} = \frac{45}{25} = 1{,}8\ \frac{1}{s}$

$i_{öz} = A \cdot e^{-1,8\,t}$

$I_L(\infty) = i_{zor} = \frac{18}{10 + \frac{10 \cdot 40}{50}} \cdot \frac{1}{40 + 10} \cdot 10 = 0{,}2\ A$

$I_L(t) = A \cdot e^{-\frac{t}{\tau}} + I_L(\infty)$

$i(t) = A \cdot e^{-1,8\,t} + 0{,}2$

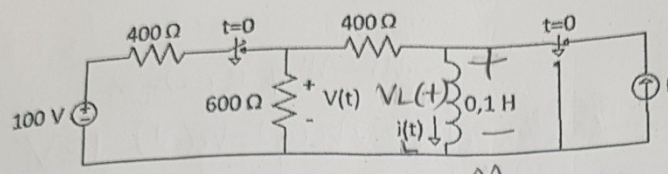
$i(0) = A + 0{,}2 = 0 \qquad A = -0{,}2$

$i(t) = 0{,}2 - 0{,}2 \cdot e^{-1,8\,t}$ $V_L(t) = L \cdot \frac{di}{dt} = 25 \cdot 0{,}2 \cdot 1{,}8 \cdot e^{-1,8\,t} = 9 \cdot e^{-1,8\,t}$

$\frac{v}{10} + \frac{v-18}{10} + \frac{v-9 \cdot e^{-1,8\,t}}{40} = 0$ $\qquad 9v - 72 - 9 \cdot e^{-1,8\,t} = 0$

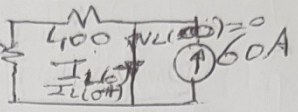
$v(t) = [8 + e^{-1,8\,t}]\ u(t) \quad V$

11)



$v(t) = ?$
$I_L(t) = ?$
$V_L(t) = ?$

Çözüm:



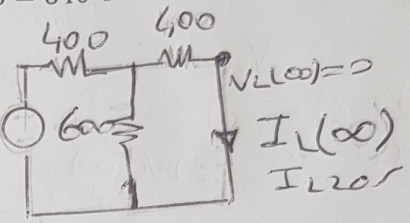
$i(0^-) = 60\ A = I_L(0^+)$ $\quad v(0) = 0$

$i_{öz} = A \cdot e^{-\frac{R}{L}t}$ $\quad R_{es} = \frac{400 \cdot 600}{1000} + 400 = 640\ \Omega$

$\frac{R}{L} = \frac{640}{0,1} = 6400 = \frac{1}{\tau}$ $\quad i_{öz} = A \cdot e^{-6400\,t}$

$\tau = R_{es}$

$i_{zor} = \frac{100}{400 + \frac{600 \cdot 400}{1000}} \cdot \frac{6}{10} = 0,09375\ A$



$I_L(t) = A\, e^{-\frac{t}{\tau}} + I_L(\infty)$

$i(t) = A \cdot e^{-6400\,t} + 0,09375$

$i(0^+) = 60 = A + 0,09375$ $\quad A = 59,906$

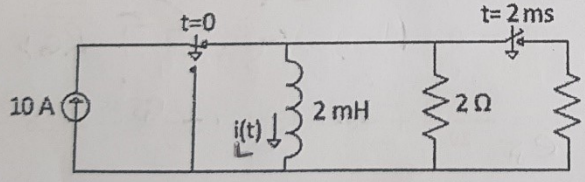
$i(t) = 0,09375 + 59,906 \cdot e^{-6400\,t}$ $\quad V_L(t) = L\frac{di_L(t)}{dt}$

$V_L(t) = 0,1 \cdot 59,906 \cdot (-6400)\, e^{-6400\,t}$

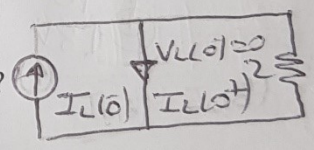
$v(t) = 400 \cdot i(t) + 0,1 \cdot \frac{di}{dt}$

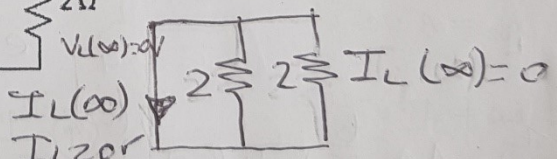
$v(t) = 37,5 + [\,400 \cdot 59,9 - 6400 \cdot 59,9 \cdot 0,1\,] \cdot e^{-6400\,t}\ \ V$

12)



$I_L(t) = ?$
$V(t) = ?$





Çözüm: $i(0^-) = 10\ A = I_L(0^+)$

$0^+ \le t \le 2\,ms$ $\quad i(t) = 10 \cdot e^{-\frac{2000}{2}t} = 10 \cdot e^{-1000\,t}$

$t = 2 \cdot 10^{-3}\ s$ $\quad i(2m) = 10 \cdot e^{-2} = 3,68\ A$

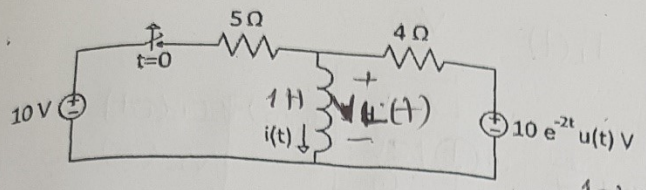
bu 2ms deki
$I_L(0^-) = I_L(0^+)$

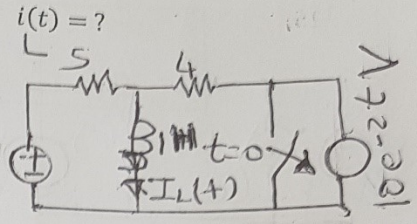
$i(t) = 3,68 \cdot e^{-\frac{10^3}{2}(t - 2 \cdot 10^{-3})}\ A$ $\quad (t \ge 2\,ms)$

2ms sonraki $I_L(\infty) = 0$

hulbuki devrede kaynak yokfakat selfin üzerindeki akim halavar (2ms)

13)

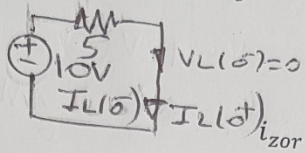




Çözüm:

$i(0^-) = \frac{10}{5} = 2\ A = I_L(0^+)$ $\quad i_{öz} = A \cdot e^{-\frac{4}{1}t} = A \cdot e^{-4t}$

Devre denklemi; $t \geq 0^+$ için;



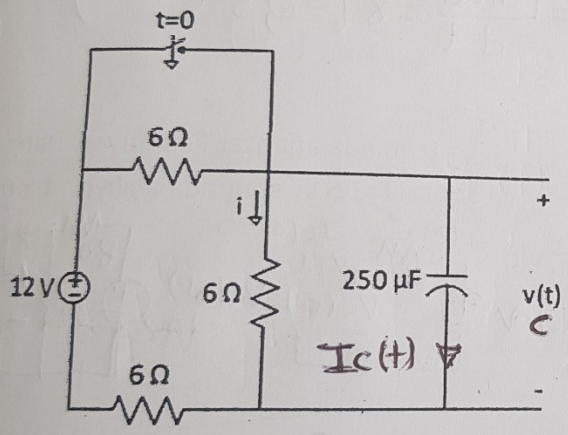
$-10 \cdot e^{-2t} + 4i + \frac{di}{dt} = 0$ $\quad i_{zor} = K \cdot e^{-2t}$

$-10 \cdot e^{-2t} + 4K \cdot e^{-2t} - 2K \cdot e^{-2t} = 0$ $\quad 2K = 10$, $K = 5$

$i_{zor} = 5 \cdot e^{-2t}$ $\quad i(t) = 5 \cdot e^{-2t} + A \cdot e^{-4t}$

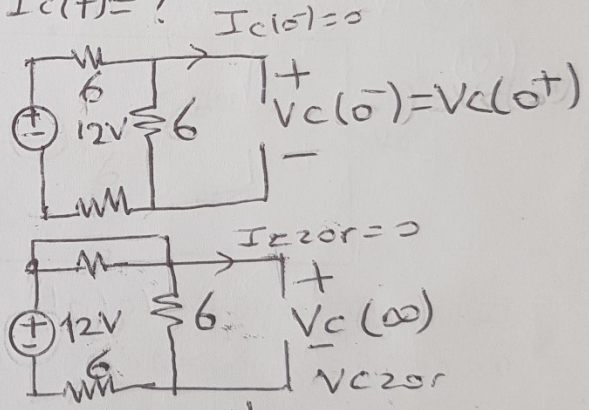
$i(0) = 2 = 5 + A$ $\quad A = -3$ $\quad i(t) = [5 \cdot e^{-2t} - 3 \cdot e^{-4t}]\,u(t)$ A

14)



$v(t) = ?$

$I_C(t) = ?$



Çözüm:

$i(0^-) = \frac{12}{18}\ A$ $\quad v_C(0^-) = \frac{12}{18} \cdot 6 = 4\,V = V_C(0^+)$

$v_{C\,öz} = A \cdot e^{-\frac{t}{RC}}$ $\quad R_{eş} = \frac{6 \cdot 6}{12} = 3\ \Omega$ $\quad \tau = R_{eş} \cdot C = 3 \cdot 10^{-6} \cdot 250 = 0{,}750 \cdot 10^{-3}\ \frac{1}{s}$

$v_{C\,öz} = A \cdot e^{-1{,}333\,t}$ $\quad i_{zor} = \frac{12}{12} = 1\ A$ $\quad v_{C\,zor} = 1 \cdot 6 = 6\ V$

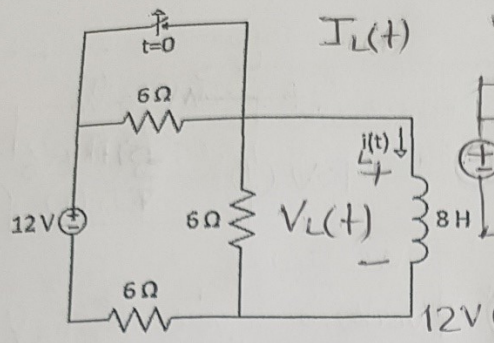
$v_C(t) = A \cdot e^{-1{,}333\,t} + 6$ $\quad v_C(0^+) = 4 = A + 6$ $\quad A = -2$

$V_C(t) = A e^{-\frac{t}{\tau}} + V_C(\infty)$

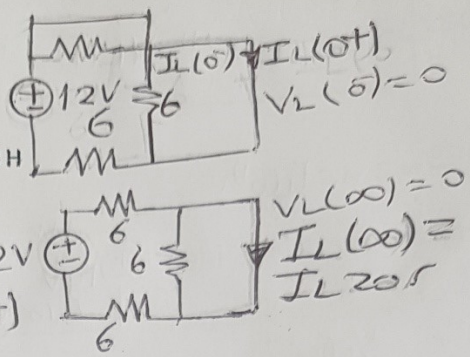
$v_C(t) = [6 - 2 \cdot e^{-1{,}333\,t}]\,u(t)$ V

$I_C(t) = C \frac{dV_C(t)}{dt} = 250 \times 10^{-6} \left[(-2) \cdot (-1{,}333) \cdot e^{-1{,}333t}\right]$

15)



$I_L(t)$ $V_L(t) = ?$



Çözüm: $i(0^-) = \frac{12}{6} = 2\ A = I_L(0^+)$

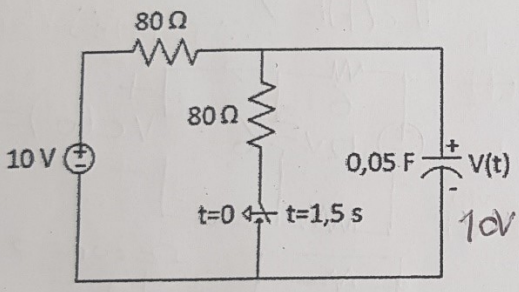
$i_{öz} = A \cdot e^{-\frac{R}{L}t}$ $\quad R_{eş} = \frac{6 \cdot 12}{18} = 4\ \Omega$ $\quad r = \frac{R_{eş}}{L} = \frac{4}{8} = 0{,}5\ \frac{1}{s}$

$i_{öz} = A \cdot e^{-0{,}5\,t}$ $\quad i_{zor} = \frac{12}{12} = 1\ A = I_L(\infty)$ $\quad \tau = \frac{L}{R_{eş}}$ $\quad r = -\frac{1}{\tau}$

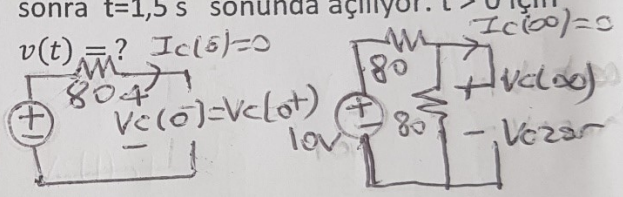
$i(t) = A \cdot e^{-0{,}5\,t} + 1$ $\quad i(0) = 2 = A + 1$ $\quad A = 1$

$i(t) = [e^{-0{,}5\,t} + 1]\,u(t)\ \ A$ $\quad V_L(t) = L\frac{di_L(t)}{dt} = 8(-0{,}5\,e^{-0{,}5t})$

16)



t = 0 anında anahtar kapanıyor. Daha sonra t=1,5 s sonunda açılıyor. t > 0 için $v(t) = ?$



Çözüm: $v(0^-) = 10\ V = V_C(0^+)$

$0 < t \le 1{,}5\ s$ $\quad v_{öz} = A\,e^{-\frac{t}{R_{eş}C}}$ $\quad R_{eş} = \frac{80 \cdot 80}{160} = 40\ \Omega$ $\quad RC_{eş} = 40 \cdot 0{,}05 = 2\ s$

$v(t) = A \cdot e^{-0{,}5\,t}$ $\quad v_{zor} = \frac{10}{16} \cdot 8 = 5\ V$ $\quad v(t) = A \cdot e^{-0{,}5\,t} + 5$

$v(0) = A + 5 = 10$ $\quad A = 5$ $\quad v(t) = 5 \cdot e^{-0{,}5\,t} + 5\ V$ $\quad (0 < t \le 1{,}5)$

$v(1{,}5) = 7{,}36\ V$ $\quad t = 1{,}5\ s$ $\quad v_{öz} = A \cdot e^{-\frac{t}{RC}}$ $\quad RC_{eş} = 80 \cdot 0{,}05 = 4\ s$

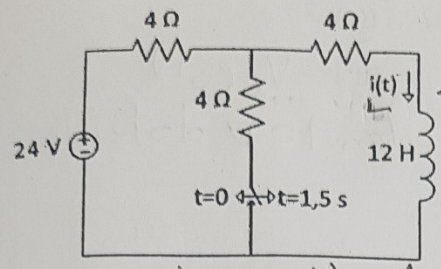
$v_{zor} = 10\ V$ $\quad v(t) = 10 + A \cdot e^{-0{,}25\,t}$

$v(1{,}5) = 7{,}36 = A + 10$ $\quad A = -2{,}64$

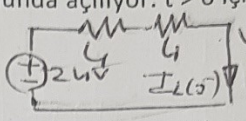
$v(t) = [10 - 2{,}64 \cdot e^{-0{,}25\,(t-1{,}5)}]\,u(t)\ \ V$ $\quad (t \ge 1{,}5\ s)$

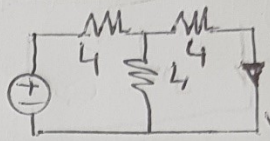
1,5 sn. önceki

17)



t = 0 anında anahtar kapanıyor. Daha sonra t=1,5 s sonunda açılıyor. t > 0 için $i(t) = ?$





$I_L(0^-)=I_L(0^+)=3A$

Çözüm:

$i(0^-) = \frac{24}{8} = 3\ A = I_L(0^+)$ $i(t) = A \cdot e^{-\frac{R}{L}t}$

$R_{eş} = \frac{4 \cdot 4}{8} + 4 = 6\,\Omega$ $\tau = \frac{R_{eş}}{L} = 0{,}5\ \frac{1}{s}$

$i(t) = I_L(t) = A \cdot e^{-\frac{t}{\tau}} + I_L(\infty)$

$i_{öz} = A \cdot e^{-0{,}5\,t}$ $i_{zor} = \frac{24}{4+2} \cdot \frac{4}{4+4} = 2\ A$ $i(t) = 2 + A \cdot e^{-0{,}5\,t}$

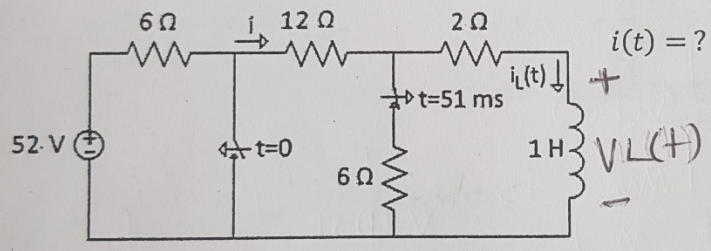
$i(0) = 2 + A = 3$ $A = 1$ $\frac{4 \cdot 4}{4+4}$ $i(t) = 2 + e^{-0{,}5\,t}\ A$ $(0 < t < 1{,}5)$

$i(1{,}5) = 2 + e^{-0{,}75} = 2{,}472\ A$ $t \geq 1{,}5\ s$ $i_{öz} = A \cdot e^{-\frac{8}{12}t}$

$i_{zor} = \frac{24}{8} = 3\ A$ $i(t) = A \cdot e^{-0{,}667\,t} + 3$ $i(0) = A + 3 = 2{,}47$

$A = -0{,}53$ $i(t) = \left[3 - 0{,}53 \cdot e^{-0{,}667\,(t-1{,}5)}\right] u(t)\ \ A$ $(1{,}5 \geq t)$

18)



$i(t) = ?$

Çözüm:

$t \leq 51\ ms$ $i_L(0^-) = \frac{52}{6 + 12 + \frac{6 \cdot 2}{8}} \cdot \frac{6}{8} = 2\ A = I_L(0^+)$ $i_{L_{zor}} = 0$ kaynak yok

$i_{L_{öz}} = A \cdot e^{-\frac{R}{L}t}$ $R_{eş} = \frac{12 \cdot 6}{18} + 2 = 6\,\Omega$ $\tau = \frac{R_{eş}}{L} = 6\ \frac{1}{s}$ $i_L(t) = 2\,e^{-6\,t}$

$i(0^-) = 2 \cdot \frac{8}{6} = \frac{8}{3}\ A$ $i(t) = \frac{8}{3} \cdot e^{-6\,t}$ $\tau = \frac{1}{r}$ $(0 \leq t \leq 51\ ms)$

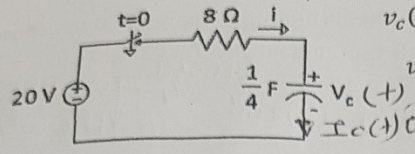
$t \geq 51\ ms$ $i(51\ ms) = \frac{8}{3} \cdot e^{-6 \cdot 51 \cdot 10^{-3}} = \frac{8}{3} \cdot \frac{1}{e^{0{,}306}} = 1{,}96\ A$

$\tau = \frac{R_{eş}}{L} = \frac{14}{1}\ \frac{1}{s}$ $i_{zor} = 0$

$i_L(t) = \left[1{,}96 \cdot e^{-14\,(t-0{,}051)}\right] u(t)\ \ A$ $R_{eş} = (12+2) = 14$ $(t > 51\ ms)$

$I_L(0) = 2{,}1666 \frac{6}{2+6} = 2$

19)



$v_c(t) = ?$, $i(t) = ?$

$v_c(0^-) = 10\ V = v_c(0^+)$

$i_c(t)$ önceden 10 V dolu idi

Çözüm:

$v_{C_{öz}} = A \cdot e^{-\frac{t}{RC}}$ $\qquad RC = 8 \cdot \frac{1}{4} = 2\ s$ $\qquad v_{C_{öz}} = A \cdot e^{-0,5\,t}$

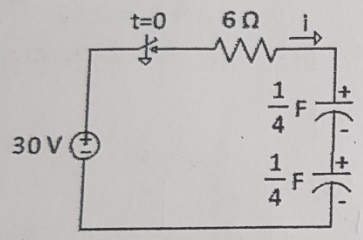
$v_{C_{zor}} = 20\ V$ $\qquad v_c(t) = A \cdot e^{-0,5\,t} + 20$ $\qquad v_c(0) = A + 20 = 10$ $\qquad A = -10$

$v_c(t) = 20 - 10 \cdot e^{-0,5\,t}\ V \qquad (t \geq 0)$

$i(t) = C \cdot \frac{dv_c}{dt}$

$i(t) = \frac{1}{4} \cdot 5 \cdot e^{-0,5\,t} = \frac{5}{4} \cdot e^{-0,5\,t}\ A \qquad (t \geq 0)$

20)



$v_c(t) = ?$, $i(t) = ?$

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

Çözüm:

$C_e = \frac{C \cdot C}{2\,C} = \frac{\frac{1}{4} \cdot \frac{1}{4}}{\frac{2}{4}} = \frac{1}{8}\ F$

$C_e \cdot R = \frac{6}{8}\ s$ $\qquad v_{C_{e_{öz}}} = A \cdot e^{-\frac{t}{R\,C_e}} = A \cdot e^{-\frac{8}{6}t}$

$v_{C_{e_{zor}}} = 30\ V$ $\qquad v_{C_e}(t) = 30 + A \cdot e^{-\frac{8}{6}t}$ $\qquad v_{C_e}(0) = 30 + A = 0$ $\qquad A = -30$

$v_{C_e} = 30 - 30 \cdot e^{-\frac{8}{6}t}\ V$ $\qquad v_C(t) = \frac{1}{2}\ v_{C_e} = 15 - 15 \cdot e^{-\frac{8}{6}t}\ V$

$i(t) = C_e \cdot \frac{d\,v_{C_e}}{dt}$

$i(t) = \frac{1}{8} \cdot \left(30 \cdot \frac{8}{6}\right) \cdot e^{-\frac{8}{6}t} = 5 \cdot e^{-\frac{8}{6}t}\ A \qquad (t \geq 0)$