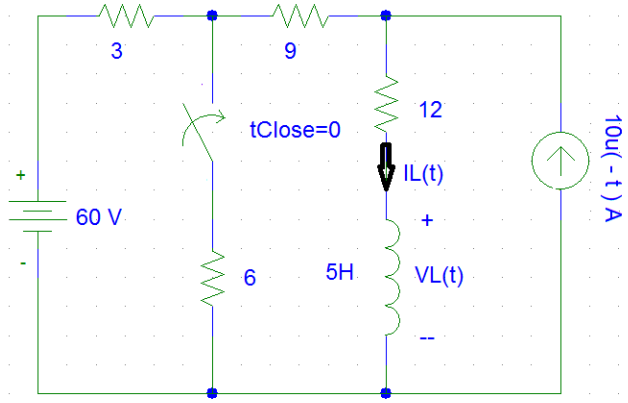
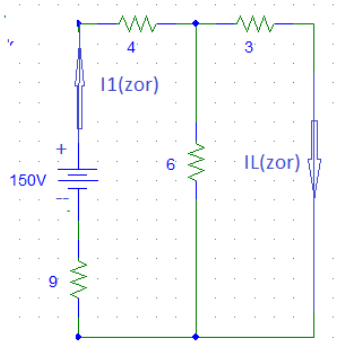
Devre Analizi Vize Sınavı 22-11-2022

İsim: No: İmza:

1-) Anahtar uzun süre açık kaldıktan sonra t = 0 anında kapatılıyor. $t \geq 0$ için IL(t) ve VL(t)'yi bulunuz.



$\frac{V-60}{12} + \frac{V}{12} + 10 = 0$ V=90 V $I_L(0^-) = \frac{90}{|12|} = 7{,}5 = I_L(0+)$



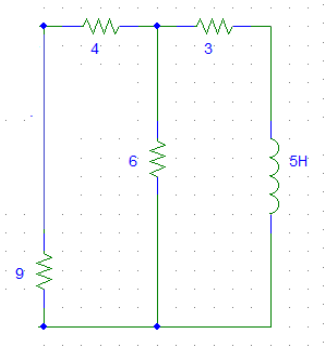
2.durum $\begin{vmatrix} 3+6 & -6 \\ -6 & 6+9+12 \end{vmatrix} \begin{vmatrix} I1zor \\ ILzor \end{vmatrix} = \begin{vmatrix} 60 \\ 0 \end{vmatrix}$

$$I_L(\infty) = \frac{\begin{vmatrix} 9 & 60 \\ -6 & 0 \end{vmatrix}}{\begin{vmatrix} 9 & -6 \\ -6 & 27 \end{vmatrix}} = \frac{9x0-(60x(-6))}{9x27-((-6)(-6))} = \frac{360}{243-36} = \frac{360}{207} = 1{,}74 = ILzor$$

$\frac{V-60}{3} + \frac{V}{6} + \frac{V}{21} = 0$ V=36,52 V

$$I_L(\infty) = \frac{36{,}52}{21} = 1{,}74 = ILzor$$

Zaman sabiti $\tau = L/R_{eş}$ $R_{eş}$ => (2. durumda selften görülen eşdeğer direnç, gerilim kaynağı kısa devre, akım kaynağı açık devre yapılarak bulunur.)



$$R_{eş} = \frac{(3+6)}{(3+6)} + 9 + 12 = 23\Omega$$

$$\tau = \frac{L}{Reş} = \frac{5}{23} = \frac{5}{23}$$

$$I_L(t) = A.\, e^{-t/(\frac{5}{23})} + 1{,}74$$

t = 0 için $I_L(0^+) = 7{,}5A$

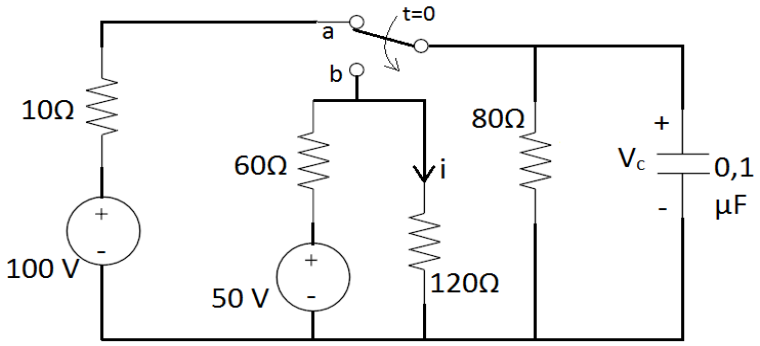
$$7{,}5 = A + 1{,}74 \qquad A = 5{,}76$$

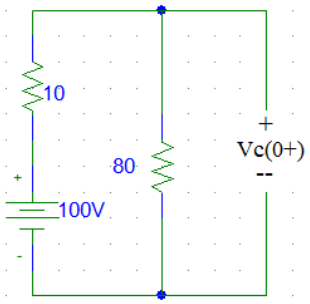
$$I_L(t) = A.\, e^{-\frac{t}{\tau}} + I_L(\infty)$$

$$I_L(t) = \left(5{,}76.\, e^{-\frac{23}{5}.t} + 1{,}74\right).u(t)A$$

$$V_L(t) = L.\frac{d_{iL}}{dt} = 5.\left(\left(-\frac{23}{5}\right).(5{,}76).\, e^{-\frac{23}{5}.t}\right)V$$

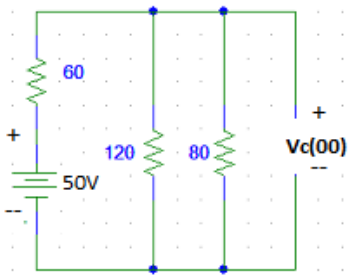
2-) Anahtar uzun bir süre **“a”** konumunda kaldıktan sonra t=0 anında **“b”** konumuna alınıyor. t≥0 için V_C(**t**)’yi , I_C(**t**) ve I(**t**) bulunuz.





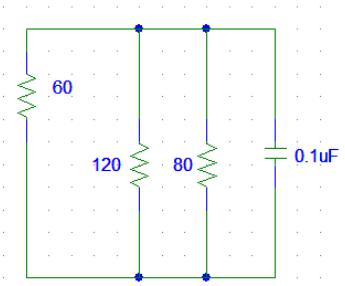
$$Vc(0-) = \frac{100}{10+80} x80 = 88{,}88V = Vc(0+)$$

$$\frac{Vc(0-)-100}{10} + \frac{Vc(0-)}{80} = 0 \qquad Vc(0-) = \frac{800}{9} = 88{,}88V = Vc(0+)$$



$$Vc(\infty) = \frac{50}{60+48} x48 = 22{,}22V$$

$$\frac{Vc(\infty)-50}{60} + \frac{Vc(\infty)}{120} + \frac{Vc(\infty)}{80} = 0 \qquad Vc(\infty) = \frac{200}{9} = 22{,}22V = Vc(0+)$$



Zaman sabiti $\tau = R_{eş}xCR_{eş} => R_{eş=}$ (2. durumda selften görülen eşdeğer direnç, gerilim kaynağı kısa devre, akım kaynağı açık devre yapılarak bulunur.)

$$Reş = \frac{60\times48}{60+48} = 26{,}66$$

$\tau = R_{eş}xC=0{,}1uF\times26{,}66=2{,}666x10^{-6}$

$Vc(t)=Ae^{-t/\tau}+Vc(\infty)$

t =0 için Vc(0+)=88.88V

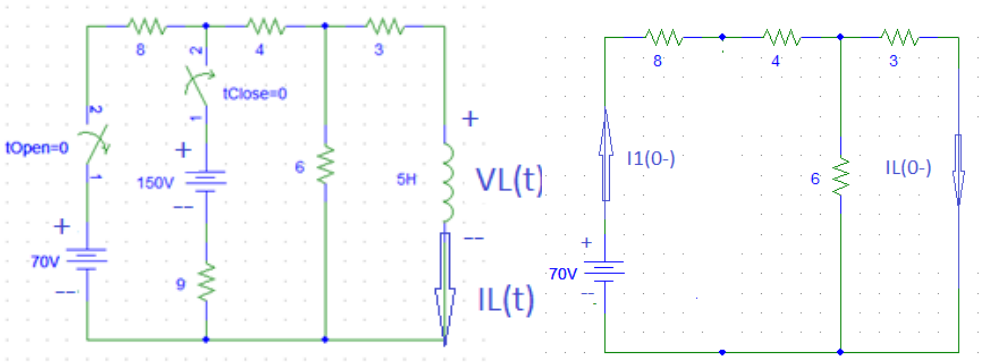
$88{,}88=A.1+22{,}22 \quad A=66{,}66 \quad Vc(t)= 66{,}666xe^{-t/2{,}666x10^{-6}} + 22{,}22$

$$Ic(t) = C\frac{dvc}{dt} = 0{,}1x10^{-6}x\frac{1}{2{,}666x10^{*6}}x66{,}666xe^{-t/2{,}666x10^{-6}}$$

$$Ic(t) = 0{,}0375xe^{-t/2{,}666x10^{-6}}$$

$$I(t) = \frac{Vc(t)}{120} = \frac{66{,}666xe^{-t/2{,}666x10^{-6}} + 22{,}22}{120}$$

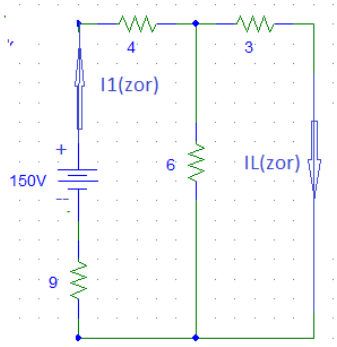
3-) 70 V'luk kaynaktaki anahtar uzun süre kapalı kaldıktan sonra t = 0 anında açılıyor. 150 V'luk kaynaktaki anahtar uzun süre anahtar ise açık kaldıktan sonra t=0 anında kapatılıyor. t ≥ 0 için IL(t) ve VL(t)'yi bulunuz.



1durum $\begin{vmatrix} 8+4+6 & -6 \\ -6 & 6+3 \end{vmatrix} \begin{vmatrix} I1(0-) \\ IL(0-) \end{vmatrix} = \begin{vmatrix} 70 \\ 0 \end{vmatrix}$

$$I_L(0^-) = \frac{\begin{vmatrix} 18 & 70 \\ -6 & 0 \end{vmatrix}}{\begin{vmatrix} 18 & -6 \\ -6 & 9 \end{vmatrix}} 1 = \frac{18x0-(70x(-6))}{18x9-((-6)(-6))} = \frac{420}{162-36} = 3{,}33 = I_L(0+)$$

$\frac{V-70}{12} + \frac{V}{6} + \frac{V}{3} = 0$ V=10 V $I_L(0^-) = \frac{V}{3} = \frac{10}{3} = 3{,}33 = I_L(0+)$

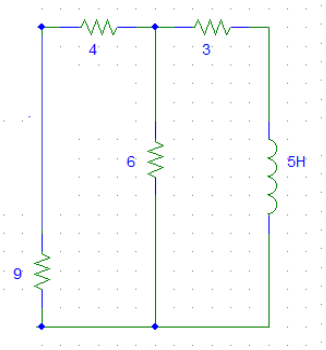


2.durum $\begin{vmatrix} 9+4+6 & -6 \\ -6 & 6+3 \end{vmatrix} \begin{vmatrix} I1zor \\ ILzor \end{vmatrix} = \begin{vmatrix} 150 \\ 0 \end{vmatrix}$

$$I_L(\infty) = \frac{\begin{vmatrix} 19 & 150 \\ -6 & 0 \end{vmatrix}}{\begin{vmatrix} 19 & -6 \\ -6 & 9 \end{vmatrix}} 1 = \frac{19x0-(150x(-6))}{19x9-((-6)(-6))} = \frac{900}{171-36} = 6{,}66 = ILzor$$

$\frac{V-150}{13} + \frac{V}{6} + \frac{V}{3} = 0$ V=20 V $I_L(\infty) = \frac{V}{3} = \frac{20}{3} = 6{,}66 = ILzor$

Zaman sabiti $\tau = L/R_{eş}$ $R_{eş}$ => (2. durumda selften görülen eşdeğer direnç, gerilim kaynağı kısa devre, akım kaynağı açık devre yapılarak bulunur.)



$$R_{eş} = \frac{(9+4)x6}{(9+4)+6} + 3 = 7{,}1\Omega$$

$$\tau = \frac{L}{Reş} = \frac{5}{7{,}1} = \frac{5}{7{,}1} \qquad r = -\frac{1}{\tau} \qquad \tau = -\frac{1}{r}$$

$$\frac{1}{4+9} + \frac{1}{6} + \frac{1}{3+5.r} = 0 \qquad \frac{1}{\frac{13}{6.(3+5.r)}} + \frac{1}{\frac{6}{13.(3+5.r)}} + \frac{1}{\frac{3+5.r}{78}} = 0$$

$$18 + 30.r + 39 + 65.r + 78 = 0 \qquad 95.r + 135 = 0 \qquad r = -1{,}42$$

$$I_L(t) = A.e^{-\frac{t}{\tau}} + I_L(\infty) \qquad I_L(t) = A.e^{-\frac{t}{\frac{5}{7{,}1}}} + 6{,}66$$

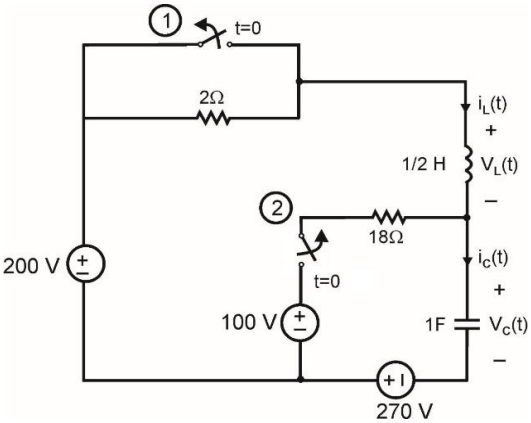
t = 0 için $I_L(0^+) = 3{,}33A$ $\qquad 3{,}33 = A + 6{,}66 \qquad A = -3{,}33$

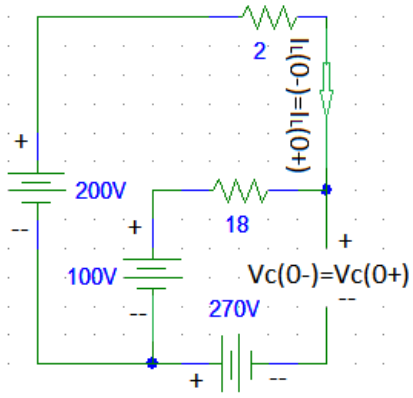
$$I_L(t) = A.e^{-\frac{t}{\tau}} + I_L(\infty)$$

$$I_L(t) = \left(-3{,}33.e^{-\frac{7{,}1}{5}.t} + 6{,}66\right).u(t)A$$

$$V_L(t) = L.\frac{d_{iL}}{dt} = 5.\left(\left(-\frac{7{,}1}{5}\right).(-3{,}33).e^{-\frac{7{,}1}{5}.t}\right)V$$

4-) 1 ve **2 nolu** anahtarlar **uzun süre kapalı kaldıktan** sonra **t=0** anında **açılıyor.** t≥0 için $\mathbf{i_L(t)}$ ve $\mathbf{V_L(t)}$'yi yada t≥0 için $\mathbf{i_C(t)}$ ve $\mathbf{V_C(t)}$'yi bulunuz.

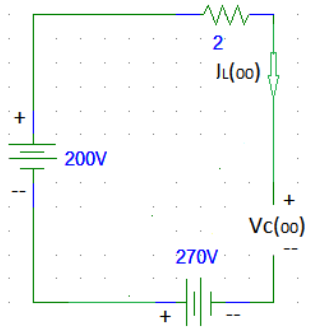




1.durum $I_L(0^-) = \frac{200-100}{18} = 5{,}555A = I_L(0^+)$

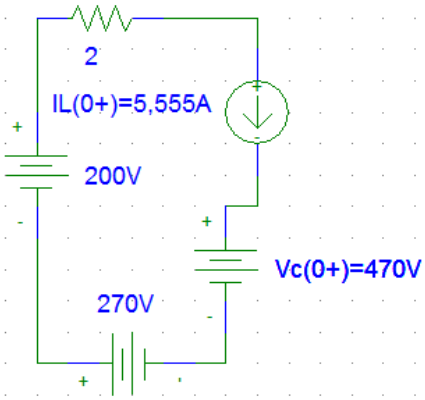
$-V_c(0^-) + 18xI_L(0^+) + 100 + 270$

$V_c(0^-) = 18x5{,}555 + 100 + 270 = 470 = V_c(0^+)$



2.durum $-200 + 2x0 - V_c(\infty) - 270 = 0$

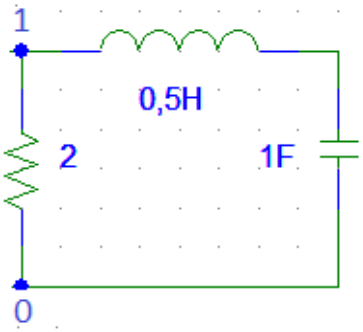
$V_c(\infty) = 470V \qquad IL(\infty) = 0$



$$-200 + 0{,}2xI_L(0^+) + V_L(0^+) + V_c(0^+) - 270 = 0$$

$$-200 + 0{,}2x5{,}555 + V_L(0^+) + 470 - 270 = 0$$

$$V_L(0^+) = -11{,}11V \qquad I_C(0^+) = 5{,}555A$$



2. durum $\frac{1}{2} + \frac{1}{0{,}5.r + \frac{1}{r.1}} = 0 \qquad \frac{1}{2} + \frac{r.1}{0{,}5.r^2+1} = 0$

$$\frac{1}{\frac{2}{0{,}5.r^2+1}} + \frac{r.1}{\frac{0{,}5.r^2+1}{2}} = 0 \qquad 0{,}5.r^2 + 1 + 2.r = 00{,}5.r^2 + 2.r + 1 = 0$$

$$r_1, r_2 = \frac{-b \mp \sqrt{b^2 - 4.a.c}}{2.a} = \frac{-2 \mp \sqrt{2^2 - 4.0{,}5.1}}{2.0{,}5} = \frac{-2 \mp \sqrt{4-2}}{1} = -2 \mp \sqrt{2}$$

$$r_1 = -0{,}586 \quad r_2 = -3{,}414 \quad (r_1 + 3{,}414).(r_2 + 0{,}586) = 0$$

$$V_c(t) = A.e^{r1.t} + B.e^{r2.t} + V_c(\infty)$$

$$V_c(t) = A.e^{-0,586.t} + B.e^{-3,414.t} + 470$$

t = 0 için $V_c(0^+) = 470 = A.1 + B.1 + 470$

$$A + B = 0$$

$$I_C(t) = C.\frac{d_{\mathrm{VC}}}{\mathrm{dt}} = (-0,586.A.e^{-0,586.t} - 3,414.b.e^{-3,414.t})$$

t = 0 için $I_c(0^+) = 5,555 = 1.\big((-0,586).A.1 + (-3,414).B.1\big)$

$$-0,586.A - 3,414.B = 5,555$$

$$+0,586.A + 0,586.B = 0 \quad -2,828.B = 5,555 \quad B == -1,9644$$

$$A + B = 0 \qquad A = 1,9644 \qquad V_c(t) = A.e^{r1.t} + B.e^{r2.t} + V_c(\infty)$$

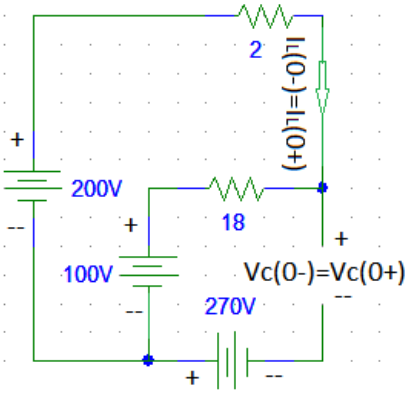
$$V_c(t) = -1,964.e^{-0,586.t} + 1,9644.e^{-3,414.t} + 470$$

$$I_C(t) = C.\frac{d_{\mathrm{VC}}}{\mathrm{dt}} = 1.\big((-0,586).A.e^{-0,586.t} + .(-3,414)B.e^{-3,414.t}\big)$$

$$I_C(t) = \big((-0,586)x1,9644.e^{-0,586.t} + .(-3,414)x(1,9644).e^{-3,414.t}\big)$$

$$I_C(t) = -1,15e^{-0,586.t} + 6,7e^{-3,414.t}$$

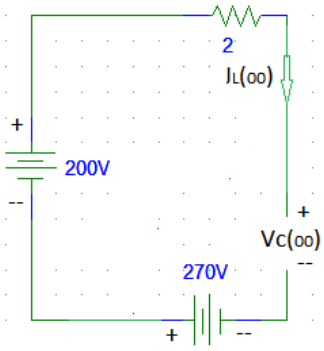
4.b) 1 ve **2 nolu** anahtarlar **uzun süre kapalı kaldıktan** sonra **t=0** anında **açılıyor.** t≥0 için $\mathbf{i_L(t)}$ ve $\mathbf{V_L(t)}$'yi bulunuz.



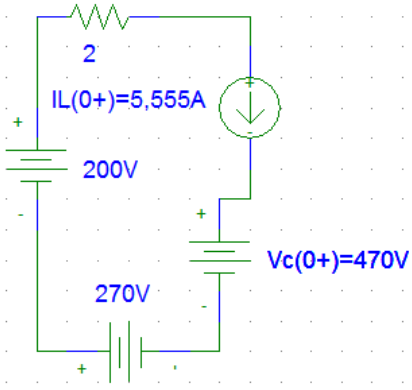
1.durum $I_L(0^-) = \frac{200-100}{18} = 5{,}555A = I_L(0^+)$

$-V_c(0^-) + 18xI_L(0^+) + 100 + 270$

$V_c(0^-) = 18x5{,}555 + 100 + 270 = 470 = V_c(0^+)$



2.durum $-200 + 2x0 - V_c(\infty) - 270 = 0 \quad V_c(\infty) = 470V \quad IL(\infty) = 0$



$-200 + 0{,}2xI_L(0^+) + V_L(0^+) + V_c(0^+) - 270 = 0$

$-200 + 0{,}2x5{,}555 + V_L(0^+) + 470 - 270 = 0$

$V_L(0^+) = -11{,}11V \quad I_C(0^+) = 5{,}555A$

2. durum $\frac{1}{2}+\frac{1}{0{,}5.r+\frac{1}{r.1}}=0$ $\frac{1}{2}+\frac{r.1}{0{,}5.r^2+1}=0$

$\frac{1}{\frac{2}{0{,}5.r^2+1}}+\frac{r.1}{\frac{0{,}5.r^2+1}{2}}=0$ $0{,}5.r^2+1+2.r=00{,}5.r^2+2.r+1=0$

$$r_1,r_2=\frac{-b\mp\sqrt{b^2-4.a.c}}{2.a}=\frac{-2\mp\sqrt{2^2-4.0{,}5.1}}{2.0{,}5}=\frac{-2\mp\sqrt{4-2}}{1}=-2\mp\sqrt{2}$$

$r_1=-3{,}414 r_2=-0{,}586$ $(r_1+3{,}414).(r_2+0{,}586)=0$

$I_L(t)=A.e^{r1.t}+B.e^{r2.t}+I_L(\infty)$ $I_L(t)=A.e^{-0{,}586.t}+B.e^{-3{,}414.t}+0$

t = 0 için $I_L(0^+)=5{,}555=A.1+B.1+0$ $A+B=5{,}555$

$$V_L(t)=L.\frac{d_{\text{İL}}}{\text{dt}}=(-0{,}586.A.e^{-0{,}586.t}-3{,}414.b.e^{-3{,}414.t})$$

t = 0 için $V_L(0^+)=-11{,}11=\frac{1}{2}.\big((-0{,}586).A.1+(-3{,}414).B.1\big)$

$-0{,}586.A-3{,}414.B=-22{,}22$

$+0{,}586.A+0{,}586.B=3{,}255$

$-2{,}828.B=-18{,}9672$ $B=6{,}7$ $A+B=5{,}555$ $A=-1{,}157$

$I_L(t)=A.e^{r1.t}+B.e^{r2.t}+I_L(\infty)$

$I_L(t)=-1{,}157.e^{-0{,}586.t}+6{,}7.e^{-3{,}414.t}+0$

$$V_L(t)=L.\frac{d_{\text{İL}}}{\text{dt}}=\frac{1}{2}(-0{,}586x(-1{,}157).e^{-0{,}586.t}-3{,}414x6{,}7.e^{-3{,}414.t})$$

$V_L(t)=0{,}34.e^{-0{,}586.t}+11{,}44.e^{-3{,}414.t}$