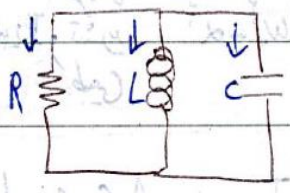
مدار RLC موازی



$\alpha = \frac{1}{2RC}$ ضریب میرایی

$\omega_0 = \frac{1}{\sqrt{LC}}$ فرکانس تشدید

اگر $\alpha > \omega_0 \Rightarrow s_{1,2} = -\alpha \pm \sqrt{\alpha^2 - \omega_0^2}$ ، $V_c(t) = Ae^{s_1 t} + Be^{s_2 t}$

میرایی شدید (فوق میرا)

اگر $\alpha = \omega_0 \Rightarrow s_{1,2} = -\alpha$ $V_c(t) = (A + Bt)e^{-\alpha t}$ میرایی بحرانی

اگر $\alpha < \omega_0 \Rightarrow \omega_d = \sqrt{\omega_0^2 - \alpha^2}$ فرکانس تشدید طبیعی ، $V_c(t) = e^{-\alpha t}(A\cos\omega_d t + B\sin\omega_d t)$

زیر میرا (میرایی ضعیف)

اگر $\alpha = 0 \Rightarrow$ $V_c(t) = A\cos\omega_d t + B\sin\omega_d t$ نوسانی

Raz

بدست آوردن A و B :

۱ با قرار دادن $V_{C(0)}$ در معادله یک رابطه بین A و B بدست می‌آید.

۲ معادله‌ی KCL را نوشته و با قرار دادن $I_{R(0)}=\frac{V_{C(0)}}{R}$ و $I_{L(0)}$ و گرفتن مشتق از معادله $V_{C(t)}$ و بدست آوردن $I_{C(0)}$ یک رابطه دیگر بین A و B بدست می‌آید.

مدار RLC سری

ضریب میرایی $\alpha=\frac{R}{2L}$

فرکانس تشدید $\omega_0=\frac{1}{\sqrt{LC}}$

اگر $\alpha>\omega_0 \Rightarrow S_{1,2}=-\alpha\pm\sqrt{\alpha^2-\omega_0^2}$ ، $I_{L(t)}=Ae^{S_1 t}+Be^{S_2 t}$

میرایی شدید (فوق میرا)

اگر $\alpha=\omega_0 \Rightarrow$ $I_{L(t)}=(A+Bt)e^{-\alpha t}$ میرایی بحرانی

اگر $\alpha<\omega_0 \Rightarrow \omega_d=\sqrt{\omega_0^2-\alpha^2}$ ، $I_{L(t)}=e^{-\alpha t}(A\cos\omega_d t+B\sin\omega_d t)$

فرکانس تشدید طبیعی

زیر میرا (میرای ضعیف)

اگر $\alpha=0 \Rightarrow$ $I_{L(t)}=A\cos\omega_d t+B\sin\omega_d t$ نوسانی

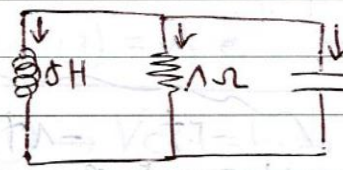
بدست آوردن مقادیر اولیه A و B

۱) با قرار دادن $I_{L(0)}$ در معادله یک رابطه بین A و B بدست می‌آید.

۲) معادله KVL را نوشته و با قرار دادن $V_{R(0)}=RI_{L(0)}$ و $V_{C(0)}$ و گرفتن مشتق از معادله $I_{L(t)}$ و بدست آوردن $V_{L(0)}$ یک رابطه دیگر بین A و B بدست می‌آید.

$V_{L(0)}$

مثال ص ۲۳ سوال ۴:



$I_{L(0)} = 8\,A$ ، $V_{C(t)} = ?$

$V_{C(0)} = 40\,V$ ، $I_{L(t)} = ?$

$$\alpha = \frac{1}{2RC} = \frac{1}{2(8)(125\times10^{-6})} = 5$$

$$\omega_0 = \frac{1}{\sqrt{LC}} = \frac{1}{\sqrt{5\times125\times10^{-6}}} = 4$$

$\Rightarrow \alpha > \omega_0$ میرا فوق‌العاده

$$s_{1,2} = -\alpha \pm \sqrt{\alpha^2 - \omega_0^2} = -5 \pm \sqrt{25-16} = \begin{cases} -1 \\ -9 \end{cases}$$

$$V_C(t) = Ae^{-1t} + Be^{-9t}$$

① $\rightarrow V_{C(0)} = 40 \Rightarrow Ae^{0} + Be^{0} = 40 \Rightarrow \boxed{A+B=40}$

② $\Rightarrow$ KCL $\Rightarrow I_{L(0)} + I_{R(0)} + I_{C(0)} = 0$ $\quad I_{R(0)} = \frac{V_{C(0)}}{R} = \frac{40}{8} = 5A$

$$I_{C(t)} = C\frac{dV}{dt} = 125\times10^{-6}\left(-2Ae^{-1t} - 8Be^{-9t}\right)$$

$$\Rightarrow I_{C(0)} = 125\times10^{-6}\left(-2Ae^{0} - 8Be^{0}\right) = -0.25A - 0.1B$$

KCL $\Rightarrow 8 + 5 - 0.25A - 0.1B = 0 \Rightarrow \boxed{A + 4B = 52}$

$$\begin{cases} A+B=40 \\ A+4B=52 \end{cases} \Longrightarrow \begin{matrix} A=-12 \\ B=12 \end{matrix} \Rightarrow \boxed{V_C(t) = -12e^{-1t} + 12e^{-9t}}$$

Raz

۴۳

جواب ج

KCL $\Rightarrow I_R(t) + I_C(t) + I_L(t) = 0$

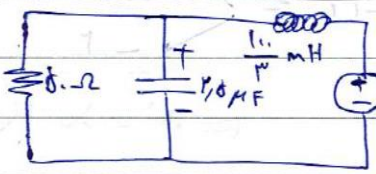
$$I_R(t) = \frac{V_{C(t)}}{R} = \frac{-12e^{-2t} + 16e^{-8t}}{8} = -1.5e^{-2t} + 2e^{-8t}$$

$$I_C(t) = C\frac{dv}{dt} = 12.5\times10^{-6}\left(44e^{-2t} - 128e^{-8t}\right) = 3e^{-2t} - 16e^{-8t}$$

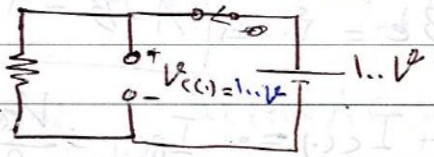
$$KCL \Rightarrow -1.5e^{-2t} + 2e^{-8t} + 3e^{-2t} - 16e^{-8t} + I_L(t) = 0$$

$$I_L(t) = 12e^{-2t} - 4e^{-8t}$$ جواب

سوال ۲۳ ص



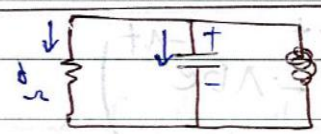
$I_L(t) = ?$



با توجه به شرایط مدار در $t=0^-$ داریم: $V_C(0^-) = 100V$

$I_{R(0^-)} = 2A$

$I_{L(0^-)} = 2A$



$$\alpha = \frac{1}{2RC} = \frac{1}{2(5)(2.5\times10^{-6})} = 4000$$

$$\omega_0 = \frac{1}{\sqrt{LC}} = \frac{1}{\sqrt{\frac{1}{2}\times2.5\times10^{-6}}} = 2000\sqrt{2}$$

$$\alpha > \omega_0 \Rightarrow S_{1,2} = -\alpha \pm \sqrt{\alpha^2 - \omega_0^2}$$

$$S_{1,2} = -4000 \pm \sqrt{(4000)^2 - (2000\sqrt{2})^2} = \begin{cases} -4000 \\ -2000 \end{cases}$$

Raz

(۲) C را حذف

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$$V_C(t) = A e^{-۲۰۰t} + B e^{-۴۰۰t}$$

① $\rightarrow V_C(۰) = ۱۰۰ \Rightarrow A e^{۰} + B e^{۰} = ۱۰۰ \Rightarrow A + B = ۱۰۰$

② $\rightarrow$ (KCL) $\Rightarrow I_C(۰) + I_R(۰) - I_L(۰) = ۰$

$$I_R(۰) = \frac{V_C(۰)}{R} = \frac{۱۰۰}{۵۰} = ۲A$$

$$I_C(t) = C\frac{dV}{dt} = ۲٫۵ \times ۱۰^{-۶}\left(-۲۰۰ A e^{-۲۰۰t} - ۴۰۰ B e^{-۴۰۰t}\right)$$

$$I_C(۰) = ۲٫۵ \times ۱۰^{-۶}\left(-۲۰۰A - ۴۰۰B\right) = -۰٫۰۰۵A - ۰٫۱۵B$$

(KCL) $\Rightarrow -۰٫۰۰۵A - ۰٫۱۵B + ۲ - ۲ = ۰ \Rightarrow A + ۳B = ۰$

$$\begin{cases} A + B = ۱۰۰ \\ A + ۳B = ۰ \end{cases} \Rightarrow \begin{matrix} B = -۵۰ \\ A = ۱۵۰ \end{matrix} \Rightarrow V_C(t) = ۱۵۰ e^{-۲۰۰t} - ۵۰ e^{-۴۰۰t}$$

(KCL) $\Rightarrow I_C(t) + I_R(t) - I_L(t) = ۰$

$$I_C(t) = C\frac{dV}{dt} = ۲٫۵ \times ۱۰^{-۶}\left(-۳ \times ۱۰^{۵} e^{-۲۰۰t} + ۲ \times ۱۰^{۵} e^{-۴۰۰t}\right)$$

$$I_C(t) = -۰٫۷۵ e^{-۲۰۰t} + ۰٫۷۵ e^{-۴۰۰t}$$

$$I_R(t) = \frac{V_C(t)}{R} = \frac{۱۵۰ e^{-۲۰۰t} - ۵۰ e^{-۴۰۰t}}{۵۰} = ۳e^{-۲۰۰t} - e^{-۴۰۰t}$$

(KCL) $\Rightarrow$

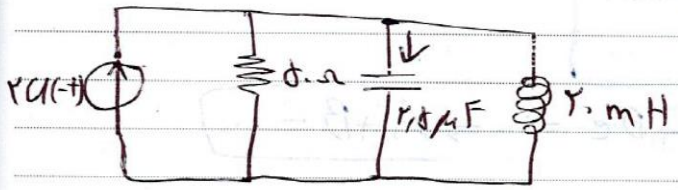
$$-۰٫۷۵ e^{-۲۰۰t} + ۰٫۷۵ e^{-۴۰۰t} + ۳e^{-۲۰۰t} - e^{-۴۰۰t} - I_L(t) = ۰$$

$$I_L(t) = ۲٫۲۵ e^{-۲۰۰t} - ۰٫۲۵ e^{-۴۰۰t}$$

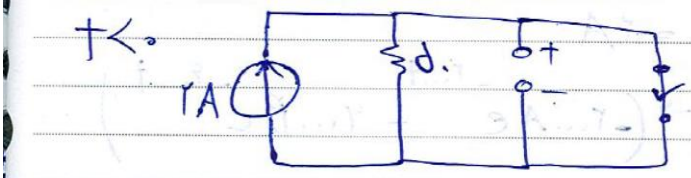
HELIA

جواب (۲۵)

ص ۲۳ سوال ۲۱:



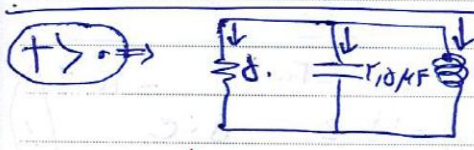
$I_c(t) = ?$



$V_c(0) = 0$ ← مدار اتصال کوتاه

$I_L(0) = 2A$

$I_R(0) = 0$



$$\alpha = \frac{1}{2RC} = \frac{1}{2(50)(2.5\times10^{-4})} = 4000$$

$$\omega_0 = \frac{1}{\sqrt{LC}} = \frac{1}{\sqrt{20\times2.5\times10^{-9}}} = 2000\sqrt{5}$$

$\Rightarrow \alpha < \omega_0 \Rightarrow$ میرای ضعیف

$$\omega_d = \sqrt{\omega_0^2 - \alpha^2} = \sqrt{(2000\sqrt{5})^2 - (4000)^2} = 2000$$

$$V_c(t) = e^{-4000t}\left(A\cos 2000t + B\sin 2000t\right)$$

$f(x)g(x) = f'(x)g(x) + f(x)g'(x)$ | $(\sin x)' = \cos x$ | $(\cos x)' = -\sin x$

D تحلیل

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بدست آوردن A و B:

$$V_C(0) = 0 \rightarrow e^{0}(A\cos 0 + B\sin 0) = 0 \Rightarrow \boxed{A = 0}$$

$$\boxed{V_C(t) = Be^{-4000t}\sin 3000t}$$

KCL $\Rightarrow I_{C(0)} + I_{R(0)} + I_{L(0)} = 0$

$$I_{R(0)} = \frac{V_{C(0)}}{R} = \frac{0}{50} = 0$$

$$I_C(t) = C\frac{dV}{dt} = 2.5\times10^{-7}\left[-4000Be^{-4000t}\sin 3000t + 3000Be^{-4000t}\cos 3000t\right]$$

$$I_{C(0)} = 2.5\times10^{-7}\left[-4000Be^{0}\sin 0 + 3000Be^{0}\cos 0\right] = 0.0075B$$

KCL $\Rightarrow 0.0075B + 0 + 2 = 0 \Rightarrow B = -4000$

$$\boxed{V_C(t) = -4000e^{-4000t}\sin 3000t}$$

$$I_C(t) = C\frac{dV}{dt}$$

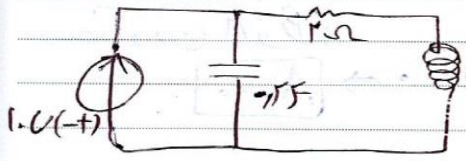
$$I_C(t) = 2.5\times10^{-7}\left[1.4\times10^{8}e^{-4000t}\sin 3000t - 0.8\times10^{8}e^{-4000t}\cos 3000t\right]$$

$$\boxed{I_C(t) = 2e^{-4000t}\left(2\sin 3000t - \cos 3000t\right)}$$ جواب

تمرین ص ۲۳ ← سوال ۱۰ و ۲۲
ص ۲۴ ← ۳۵ و ۴۵

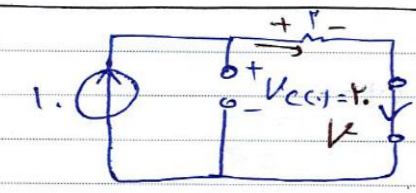
Subject:
Year: Month: Date:

ص ۲۴ سوال ۳۱ : ✓



$I_L(+) = ?$

$t < 0$

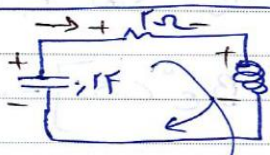


$V_C(0) = 20V$

$V_R(0) = I_R(0) \times R = 20$ ✗ / $I_R(0) = 10$ A

$I_L(0) = 10$ A

$t > 0$



$$\alpha = \frac{R}{2L} = \frac{2}{2(0.25)} = 4$$

$$\omega_0 = \frac{1}{\sqrt{LC}} = \frac{1}{\sqrt{0.25 \times 0.2}} = 2\sqrt{5}$$

میرای ضعیف $\alpha < \omega_0$

$$\omega_d = \sqrt{(2\sqrt{5})^2 - (4)^2} = 2$$

$$I_L(t) = e^{-4t}(A\cos 2t + B\sin 2t)$$

برای محاسبه A و B :

$$I_{L(-)} = 10A \rightarrow e^{0}(A\cos 0 + B\sin 0) = 10 \Rightarrow A = 10$$

$$I_L(t) = e^{-4t}(10\cos 2t + B\sin 2t)$$

HELIA

KVL $\Rightarrow -V_{C(0)} + V_{R(0)} + V_{L(0)} = 0$

$V_{R(0)} = R \cdot I_{L(0)} = 2(10) = 20$

$V_{L(t)} = L\frac{di}{dt} = 0.25\left[-4e^{-4t}(10\cos 2t + B\sin 2t) + e^{-4t}(-20\sin 2t + 2B\cos 2t)\right]$

$V_{L(0)} = 0.25\left[-4e^{0}(10\cos 0 + B\sin 0) + e^{0}(-20\sin 0 + 2B\cos 0)\right]$

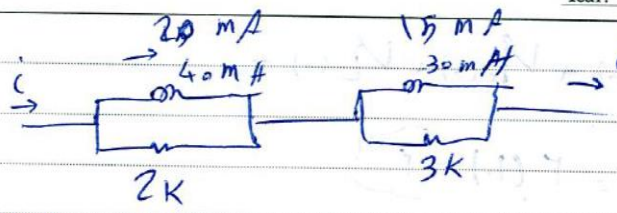
$= -10 + 0.5B$

KVL $\Rightarrow -20 + 20 - 10 + 0.5B = 0 \Rightarrow B = 20$

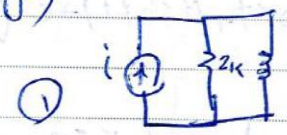
جواب:

$$I_{L(t)} = e^{-4t}(10\cos 2t + 20\sin 2t)$$

Year: Month: Date:



b)

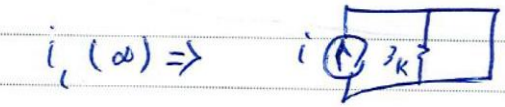


$i_L(\infty) \Rightarrow$

$R_{eq} = 2K$

$\tau = \frac{L}{R} = \frac{40\,mH}{2K} = 2\mu s$

$i_L(\infty) \Rightarrow$



$R_{eq} = 3K$

$\tau = L/R = 10\mu s$

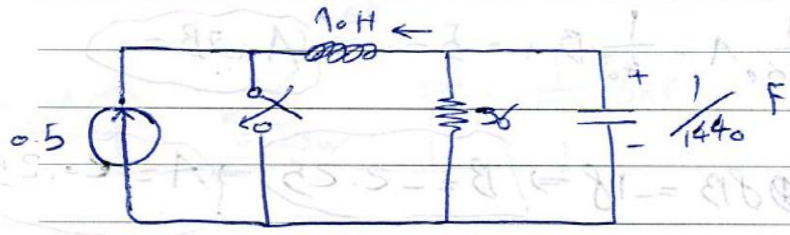
$$i_{L_1}(t) = (20 - i)e^{-t/\tau_1} + i$$

$$i_{L_2}(t) = (15 - i)e^{-t/\tau_2} + i$$

$$V_1 = L_1 \frac{di_1(t)}{dt} \Rightarrow V(t) = V_1 + V_2$$

$$V_2 = L_2 \frac{di_2(t)}{dt}$$

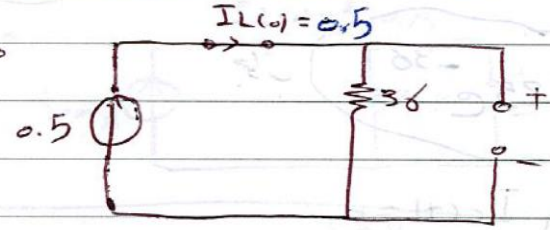
مثال ۱۲ تمرین ۱۰:



$V_c(t) = ?$

$I_L(t) = ?$

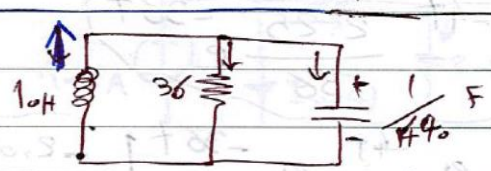
$t < 0$



$I_L(0) = 0.5$

$I_R(0) = 0.5$

$t > 0$



$$\alpha = \frac{1}{2RC} = \frac{1}{2 \times 36 \times \frac{1}{1440}} = 20$$

$$\omega_0 = \frac{1}{\sqrt{LC}} = \frac{1}{\sqrt{10 \times \frac{1}{1440}}} = 12$$

$\alpha > \omega_0 \Rightarrow$ میرا شدید

$$S_{1,2} = -20 \pm \sqrt{20^2 - 12^2} = \begin{matrix} -4 \\ -36 \end{matrix} \Rightarrow \boxed{V_c(t) = Ae^{-4t} + Be^{-36t}}$$

بدست آوردن A و B:

$$V_c(0) = 18 \Rightarrow Ae^0 + Be^0 = 18 \Rightarrow \boxed{A + B = 18}$$

$$KCL \Rightarrow -I_L(0) + I_C(0) + I_R(0) = 0$$

$$I_{R(0)} = \frac{V_{(0)}}{R} = \frac{18}{36} = 0.5$$

$$I_C(t) = C\frac{dV}{dt} \Rightarrow \frac{1}{1440}\left(-4Ae^{-4t} - 36Be^{-36t}\right)$$

$$\Rightarrow I_{C(0)} = \frac{1}{1440}(-4A - 36B) = -\frac{1}{360}A - \frac{1}{40}B$$

Raz

KCL $\Rightarrow -0.5 - \frac{1}{36}A - \frac{1}{40}B + 0.5 = 0 \Rightarrow A + 2B = 0$

$$\begin{cases} A + 2B = 0 \\ A + B = 18 \end{cases} \Rightarrow -B = -18 \Rightarrow B = -2.25 \Rightarrow A = 2.25$$

$$V_{c(t)} = 2.25e^{-4t} - 2.25e^{-36t}$$ ✓5

KCL $\Rightarrow -I_{L(t)} + I_{R(t)} + I_{C(t)} = 0$

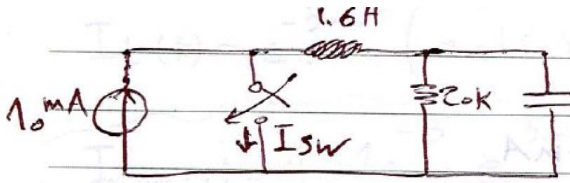
$$I_{R(t)} = \frac{V_{c(t)}}{R} = \frac{2.25}{36}e^{-4t} - \frac{2.25}{36}e^{-36t}$$

$$I_{C(t)} = C\frac{dV}{dt} = \frac{1}{1440}\left(-81e^{-4t} + 81e^{-36t}\right) = \frac{-2.025}{36}e^{-4t} + \frac{2.025}{36}e^{-36t}$$

$$I_{L(t)} = \frac{2.25}{36}e^{-4t} - \frac{2.25}{36}e^{-36t} - \frac{2.025}{36}e^{-4t} + \frac{2.025}{36}e^{-36t} = 0$$

$$I_{L(t)} = \frac{18.225}{36}e^{-4t} - \frac{0.225}{36}e^{-36t}$$ ✓5

$$i(t) = -I_L(t)$$



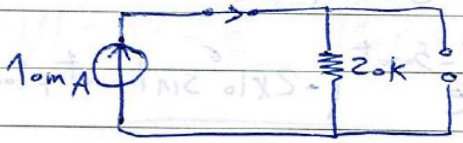
سوال 23 صفحه 23 :

$V_C(t) = ?$

$I_{sw}(t) = ?$

3

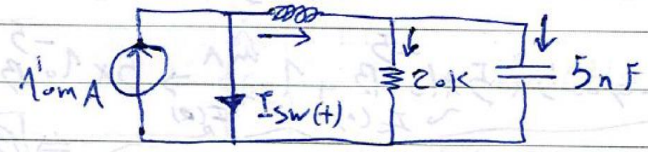
$t < 0$



$I_R(0) = 10mA$

$V_R(0) = I_R(0)R = 200V$

$t > 0$



$$\alpha = \frac{1}{2RC} = \frac{1}{2(20 \times 1.3 \times 5 \times 10^{-3})} = 5000$$

$$\omega_0 = \frac{1}{\sqrt{LC}} = \frac{1}{\sqrt{1.6 \times 5 \times 10^{-9}}} = \frac{100000}{\sqrt{80}} = 5000\sqrt{5}$$

پاسخ ضعیف

$\alpha < \omega_0$

$$\omega_d = \sqrt{(5000\sqrt{5})^2 - (5000)^2} = 10000$$

$$V_C(t) = e^{-5000t}\left(A\cos 10000t + B\sin 10000t\right)$$

بدست آوردن A و B :

$$V_C(0) = 200 \Rightarrow e^{0}\left(A\cos 0 + B\sin 0\right) = 200 \Rightarrow \boxed{A = 200}$$

$$V_C(t) = e^{-5000t}\left(200\cos 10000t + B\sin 10000t\right)$$

Raz

KCL $\Rightarrow I_L(0) = I_C(0) + I_R(0)$

$I_{R(0)} = \frac{V_{C(0)}}{R} = \frac{200}{20k\Omega} = 10mA$

$I_{C(t)} = C\frac{dV}{dt} = 5\times10^{-9}\left[-5000e^{-5000t}(200\cos10000t + B\sin10000t)\right.$

$\left. + e^{-5000t}(-2\times10^{6}\sin10000t + 10000B\cos10000t)\right]$

$I_{C(0)} = 5\times10^{-9}\left[-5000(200) + (10000B)\right] = -0.005 + 5\times10^{-5}B$

KCL $\Rightarrow 10^{mA} = -0.005 + 5\times10^{-5}B + 10^{mA} \Rightarrow 5\times10^{-5}B = 0.005$

($I_L(0)$ ↓ , $I_C(0)$ ↓ , $I_R(0)$ ↓)

$\Rightarrow B = 100$

$V_C(t) = e^{-5000t}(200\cos10000t + 100\sin10000t)$ ← (الذي

$I_{SW(t)} = 10^{mA} - I_L(t)$

KCL $\Rightarrow I_L(t) = I_C(t) + I_R(t)$

$I_{R(t)} = \frac{V_{C(t)}}{R} = 5\times10^{-5}e^{-5000t}(200\cos10000t + 100\sin10000t)$

$I_{C(t)} = C\frac{dV}{dt} = 5\times10^{-9}\left[-5000e^{-5000t}(200\cos10000t + 100\sin10000t)\right.$

$\left. + e^{-5000t}(-2\times10^{6}\sin10000t + 10^{6}\cos10000t)\right]$

$I_{C(t)} = -0.005e^{-5000t}\cos10000t - 0.0025e^{-5000t}\sin10000t -$

$0.01e^{-5000t}\sin10000t + 0.005e^{-5000t}\cos10000t$

$$I_L(t) = e^{-5000t}\left(0.01\cos 10000t - 0.0075 \sin 10000t\right)$$

$$I_{sw}(t) = 10\times10^{-3} - e^{-5000t}\left(0.01\cos 10000t - 0.0075\sin 10000t\right)$$

$$I_{sw}(t) = 10 - e^{-5000t}\left(10\cos 10000t - 7.5\sin 10000t\right)\ [mA]$$

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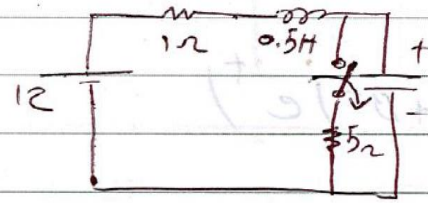
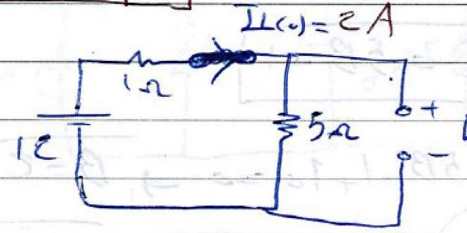
45 دیسمبر e4 ص



$V_C(t) = ?$

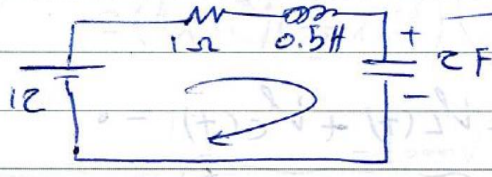
$t<0 \Rightarrow$



$I_{R_{1\Omega}}(0) = 2A$

$V_{R_{1\Omega}}(0) = 2V$

$t>0 \Rightarrow$



$$\alpha = \frac{R}{2L} = \frac{1}{2(0.5)} = 1$$

میرانی

$$\omega_0 = \frac{1}{\sqrt{LC}} = \frac{1}{\sqrt{0.5\times2}} = 1$$

$$\alpha = \omega_0 \Rightarrow I_L(t) = (A+Bt)e^{-t}$$

Raz

$I_L(0) = 2 \Rightarrow (A + B(0))e^{0} = 2 \Rightarrow A = 2$ ∴ B, A بدست آوردیم

$$I_L(t) = (2 + Bt)e^{-t}$$

KVL $\Rightarrow -12 + V_{R(0)} + V_{L(0)} + V_{C(0)} = 0$

$V_{R(0)} = R I_{L(0)} = (1)(2) = 2$ V

$$V_{L(t)} = L\frac{di}{dt} = 0.5\left(Be^{-t} - (2 + Bt)e^{-t}\right)$$

$V_{L(0)} = 0.5(B - 2) = 0.5B - 1$

KVL $\Rightarrow -12 + 2 + 0.5B - 1 + 10 = 0 \Rightarrow B = 2$

$$I_L(t) = (2 + 2t)e^{-t}$$

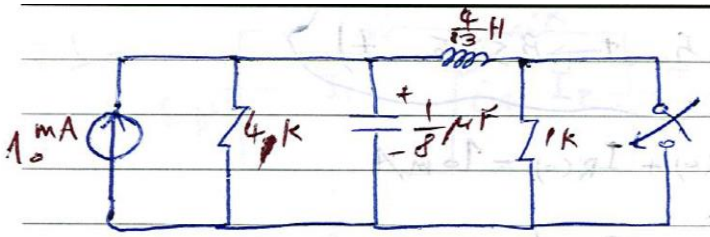
KVL $\Rightarrow -12 + V_{R(t)} + V_{L(t)} + V_{C(t)} = 0$

$V_{R(t)} = R I_L(t) = (2 + 2t)e^{-t}$

$V_L(t) = L\frac{di}{dt} = 0.5\left[2e^{-t} - (2 + 2t)e^{-t}\right] = -te^{-t}$

$\rightarrow -12 + (2 + 2t)e^{-t} - te^{-t} + V_{C(t)} = 0$

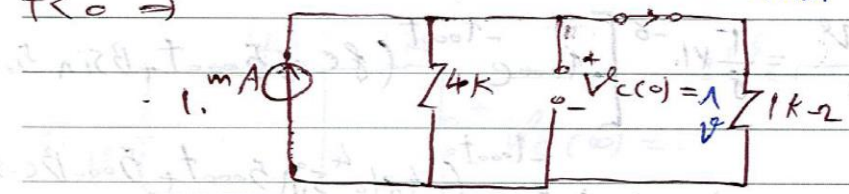
$$V_{C(t)} = 12 - 2e^{-t} - te^{-t}$$ V



$V_C(t) = ?$

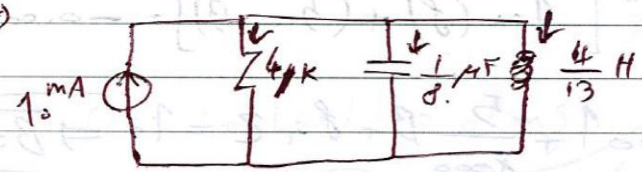
$t < 0 \Rightarrow$

$I_L(0) = 1\,mA \Rightarrow \frac{10 \times 4}{1+3} = 8\,mA$



$i_R(0) = 4\,mA$

$t > 0 \Rightarrow$



$$\alpha = \frac{1}{2RC} = \frac{1}{2(4\times10^{3})(\frac{1}{8}\times10^{-6})} = 1000$$

$$\omega_0 = \frac{1}{\sqrt{LC}} = \frac{1}{\sqrt{\frac{4}{13}\times\frac{1}{8}\times10^{-6}}} = 1000\sqrt{26}$$

$$\omega_d = \sqrt{(1000\sqrt{26})^2 - (1000)^2} = 5000$$

$$V_C(t) = e^{-1000t}(A\cos 5000t + B\sin 5000t)$$

$V_C(0) = 8 \Rightarrow$ ~~$A\cos 5000t + B\sin$~~ B و A بدست آوردن

$$e^{0}(A\cos 0 + B\sin 0) = 8 \Rightarrow A = 8$$

Raz

ΩV

$$v_c(t) = e^{-1000t}(8\cos 5000t + B\sin 5000t)$$

KCL $\Rightarrow$ $I_C(0) + I_L(0) + I_R(0) = 10\,mA$

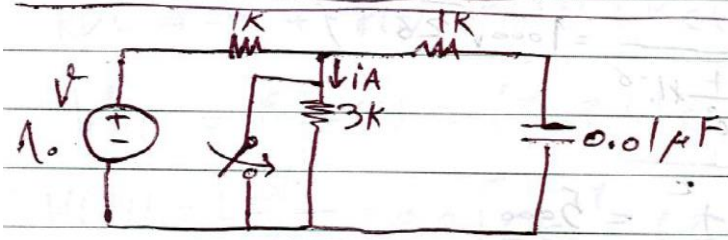
$$I_R(0) = \frac{V_C(0)}{R} = \frac{8}{4k} = 2\,mA$$

$$I_C(t) = C\frac{dv}{dt} = \frac{1}{8}\times 10^{-6}\left[-1000e^{-1000t}(8\cos 5000t + B\sin 5000t) + e^{-1000t}(-4\times 10^4 \sin 5000t + 5000B\cos 5000t)\right]$$

$$I_C(0) = \frac{1}{8}\times 10^{-6}\left[-1000(8) + (5000B)\right] = -0.001 + \frac{5}{8000}B$$

KCL $\Rightarrow -0.001 + \frac{5}{8000}B + 8 + 2 = 10 \Rightarrow B = 1.6$

$$v_c(t) = e^{-1000t}(8\cos 5000t + 1.6\sin 5000t)$$ جواب



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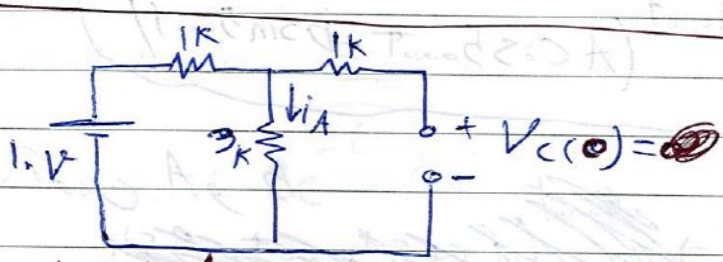
$i_A(t) = ?$

$t < 0 \Rightarrow$

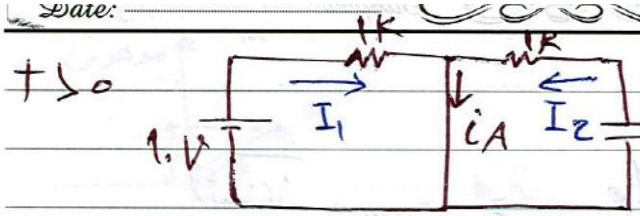


$$i_A(0) = \frac{10}{4k} = 2.5\,mA$$

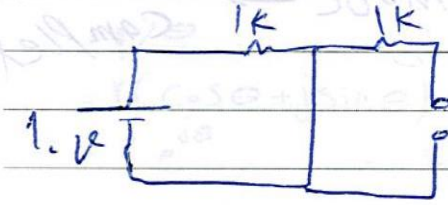
$$V_C(0) = 7.5\,V$$

Raz

ωA



$$\text{فرم کلی پاسخ} \Rightarrow v_C(t) = \left(v_C(0) - v_C(\infty)\right)e^{-t/\tau} + v_C(\infty)$$



$v_C(\infty)$: در حالت دائمی مدار

$$v_C(\infty) = 0$$

در حالت دائمی $C \to$ مدار باز

$$\tau = RC = (1k\Omega)(0.01\mu F) = 0.01\,ms$$

$$\frac{1}{\tau} = 10^5 \Rightarrow v_C(t) = 7.5e^{-10^5 t}$$

$$I_1 = \frac{10}{1k} = 10\,mA$$

$$I_2 = \frac{v_C(t)}{1k} = 7.5e^{-10^5 t} \quad [mA]$$

$$i_A(t) = I_1 + I_2 = 10 + 7.5e^{-10^5 t} \quad [mA]$$

پاسخ