Final Exam: 2021/06/09, 10:30 AM – 12:00PM including preparation/submission.

Name: 김다영

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Student ID: 12201856

Honor Code: Please write this honor code below with your signature either in Korean or in English.

"나는 정직하게 시험에 응할 것을 서약합니다.""

"By signing this pledge, I promise to adhere to exam requirements and maintain the highest level of ethical principles during the exam period."

나는 정직하게 시험에 응할것을 서약합니다.

Name/Student ID: 김다영 / 12201856 Date: 21.06.09 Signature: 김다영

Before the exam

- Camera should be on during the exam.
- Official student ID card is required for your identification.
- Official answer sheets (from I-Class) should be printed before the exam.

During the exam

- It is closed book test.
- You can use personal calculator.
- Chatting or discussion is NOT allowed.
- You need to turn on your ONE microphone during the exam.

After the exam

- Take photos (or scan) of your answer sheets and please check image quality.
- **E-mail these photos to you and to instructor: mgk@inha.ac.kr within 5 mins.**
- **Upload a combined pdf file to I-Class (midterm section) within 10 mins.**
- **Submit original papers within a week (deadline: 06.18 Fri).**

Question Number: 1

$t>0$. $\bar{I}_b = -5e^{-50t}$ [mA]

$V_a(0) = -20$

$V_c(0) = -30$

$V_d(0) = 250$.

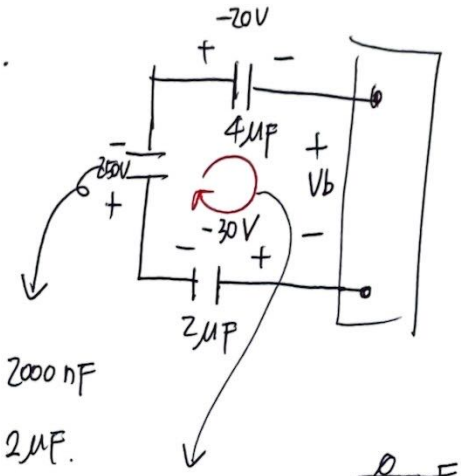
$\bar{I}_b = C\frac{dV}{dt}$

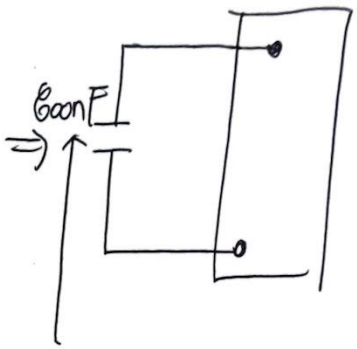
$V = \frac{1}{C}\int_{t_0}^{t} I_b\,dt + V_b(0)$

=

3

(a) $\bar{I}_1 + \bar{I}_2 = \bar{I}_b$.





~~1200.~~

$C_{eq} = 2000\,nF$

$= 2\mu F$.

~~8000F~~ $\frac{1}{2\mu F} + \frac{1}{2\mu F} + \frac{1}{4\mu F} = \frac{1}{C_{eq}'}$

$250 - 20 + V_b - 30 = 0$

$V_b = -200\,V$.

$C_{eq}' = 0.8\mu F$

$\bar{I}_b = C\frac{dV}{dt}$.

1.5

$\therefore V_b = \frac{1}{C}\int_{t_0}^{t} -5e^{-50t}\,dt + V(0)$

$= \frac{1}{0.8\mu}\int_0^t -5e^{-50t}\,dt - 200$

$= \frac{10^6}{0.8}\left[\frac{1}{10}e^{-50t}\right]_0^t - 200 = \frac{10^6}{0.8}\left(\frac{1}{10}e^{-50t} - \frac{1}{10}\right)$

$= \frac{10^5}{0.8}\left(e^{-50t} - 1\right) - 200 =$

$= 125000e^{-50t} - 125200$

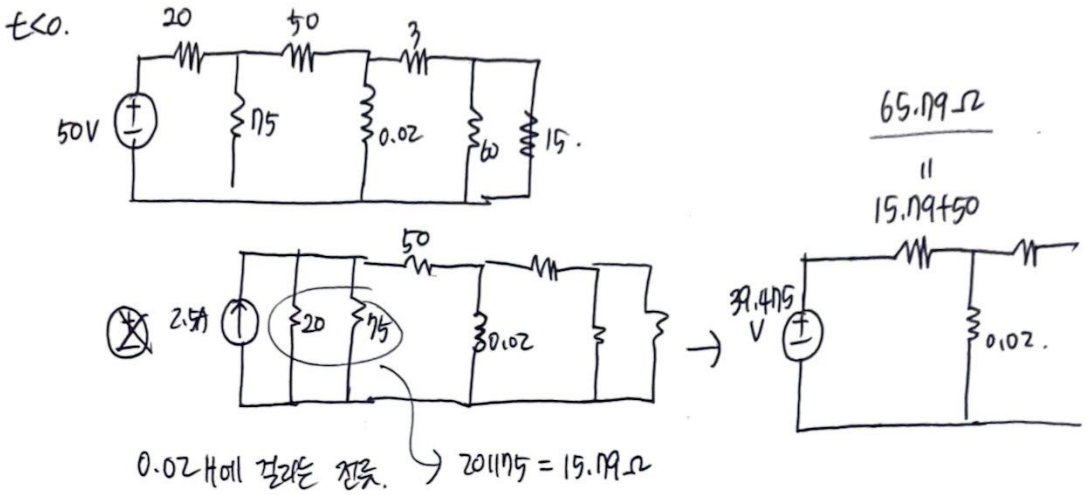
$\therefore i_1(t) = \bar{I}_b \cdot \frac{12000}{12000+8000} = -3e^{-50t}$ mA

$\therefore i_2(t) = \bar{I}_b \cdot \frac{8000}{12000+8000} = -2e^{-50t}$ (mA)

1.5

$\therefore V_a = \frac{(2\mu F \| 2\mu F)}{4\mu F + (2\mu F \| 2\mu F)} V_b$

Question Number: 2

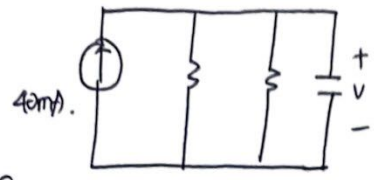


t≥0.

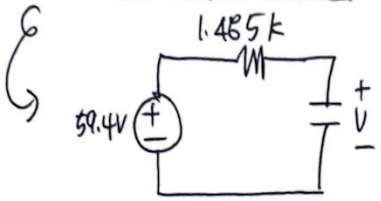
$T(t) = C\frac{dv}{dt}$

Question Number: 3

a) $t<0$.

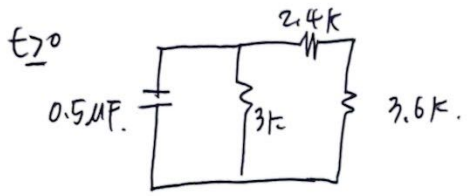


$2.7k \parallel 3.3k = 1.485k$ 13



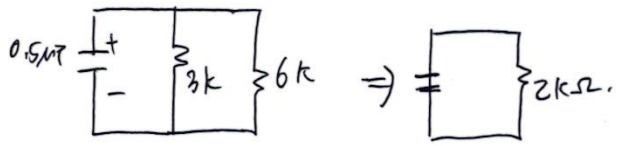
$V_{C0} = 59.4V$.

$t>0$



$\tau = RC = 2k \cdot 0.5 \cdot 10^{-6} = 1ms.$

$= 10^{-3}s.$



$V(t) = V_0 e^{-\frac{t}{\tau}} = 59.4e^{-1000t}$ [V]. 9.5

b). $I(t) = \frac{C dV}{dt} = 0.5\mu \cdot \frac{d}{dt}(59.4e^{-1000t})$

$= 0.5 \times 10^{-6} \cdot 59.4(-1000)e^{-1000t}$

$= -29.7 \cdot 10^{-3} e^{-1000t}$ 5.5

$\frac{3}{9} = \frac{1}{3}$

by. 전류분배법칙.

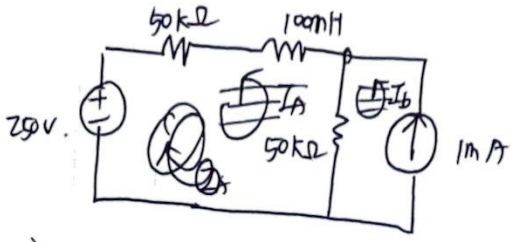
$-29.7 \cdot 10^{-3} e^{-1000t} \cdot \frac{3k \parallel}{3k+6k} =$ ~~$-29.7 \cdot 10^{-3}$~~

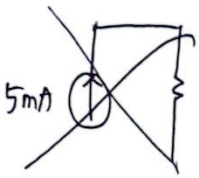
$-9.9 \cdot 10^{-3} e^{-1000t} A = i(t)$. -2

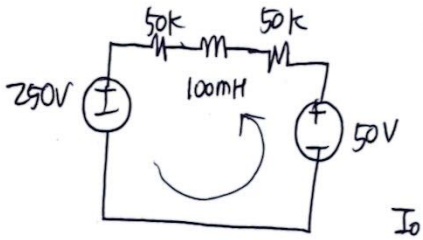
Question Number: 4 2

a)

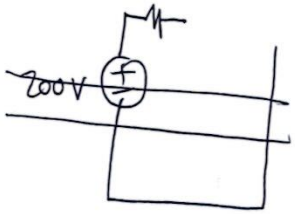
$t<0$



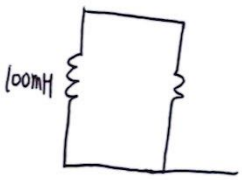




$I_0 = \frac{200}{100k} = 2mA = i$.

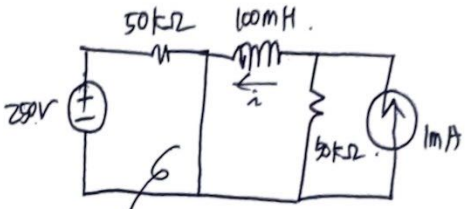


b).



b).

$t>0$



R=00이므로 250V 전원에 의한 전류가 영향을 미치지 X.

$\therefore I_p = 1mA$. (전원에 의해) 2.
1mA

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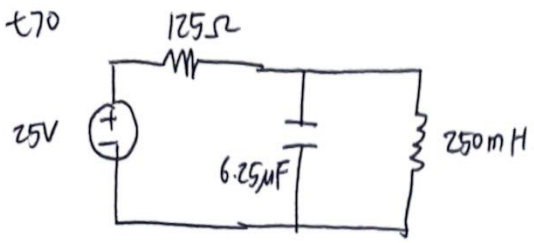
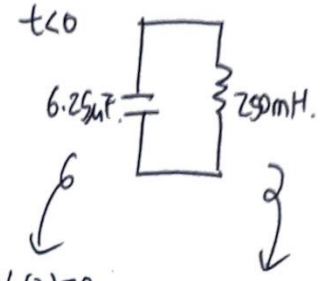
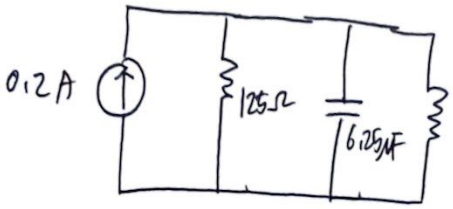
Question Number: 5





$V_c(0)=0$, $I_L(0)=0$.

because, no energy stored!



RLC, 병렬 Step. $\bar{I}_L$ 구하.

$R=125\Omega$

$C=6.25\cdot10^{-6}\,F$

$L=250\cdot10^{-3}H$.

$\bar{I}_f=0.2[A]$.

$$\alpha=\frac{1}{2RC}=\frac{1}{2\cdot125\cdot6.25\cdot10^{-6}}=640$$

$$\omega_0^2=\frac{1}{LC}=\frac{1}{6.25\times250\cdot10^{-9}}=800.$$

$\alpha^2<\omega_0^2 \Rightarrow$ underdamped!

$\omega_d=480$.

$$\bar{I}_L(t)=\bar{I}_f+B_1'e^{-640t}\cos480t+B_2'e^{-640t}\sin480t$$
$$=0.2+B_1'e^{-640t}\cos480t+B_2'e^{-640t}\sin480t.$$

$\bar{I}_L(0)=0.2+B_1'=0$. $\quad B_1'=-0.2$

$$\frac{d\bar{I}_L(t)}{dt}=\frac{V_L}{L}=0.$$

$$=-640B_1'+480B_2'$$

$$\frac{640B_1'}{480}=B_2'=\frac{640}{480}(-0.2)=-0.267$$

$\therefore V_o(t)=250\cdot10^{-3}\{128e^{-640t}\cos480t+96e^{-640t}\sin480t+110.66e^{-640t}\sin480t-128.16e^{-640t}\cos480t\}$

$\bar{I}_o(t)=\bar{I}_L(t)=0.2-0.2e^{-640t}\cos480t+(-0.267)e^{-640t}\sin480t$

$V_o(t)=L\frac{d\bar{I}_L(t)}{dt}=250\cdot10^{-3}\{0.2\cdot640e^{-640t}\cos480t+0.2e^{-640t}\sin480t\cdot480+0.267e^{-640t}\cdot640\sin480t+(-0.267)e^{-640t}\cos480t\cdot480\}$

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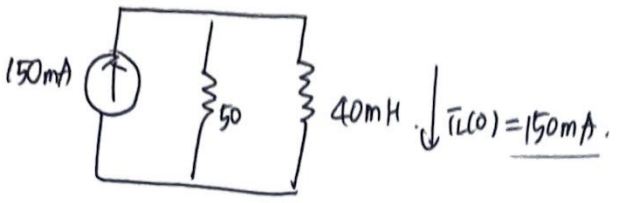
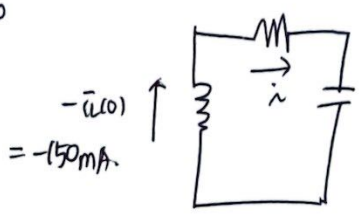
Question Number: 6

9 t<0



$i_L(0) = 150 \cdot 10^{-3}$ [A].

t≥0



$R=20\,\Omega$

$L=40\cdot10^{-3}$ H

$C=400\cdot10^{-6}$ F.

RLC회로. Natural. 과제.

$$\alpha=\frac{R}{2L}=\frac{20}{2\cdot40\cdot10^{-3}}=250$$

$$\omega_0^2=\frac{1}{LC}=\frac{1}{40\cdot400\cdot10^{-9}}=250^2.$$

$\alpha^2=\omega_0^2$ Criticaly damped!

$I(t)=D_1te^{-250t}+D_2e^{-250t}$

$I(0)=D_2=I_0=-150mA.$

$$\frac{dI(0+)}{dt}=D_1-250D_2=\frac{1}{L}(-V_R-V_C)=0.$$

$D_1=250D_2=250\cdot(-150)\cdot10^{-3}=-37500\cdot10^{-3}$

$\therefore I(t)=-37500te^{-250t}-150e^{-250t}$ [mA]

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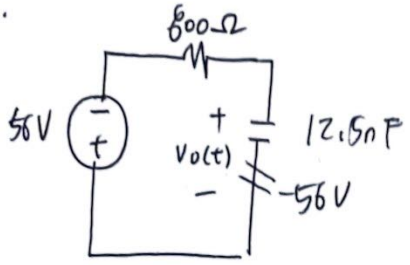
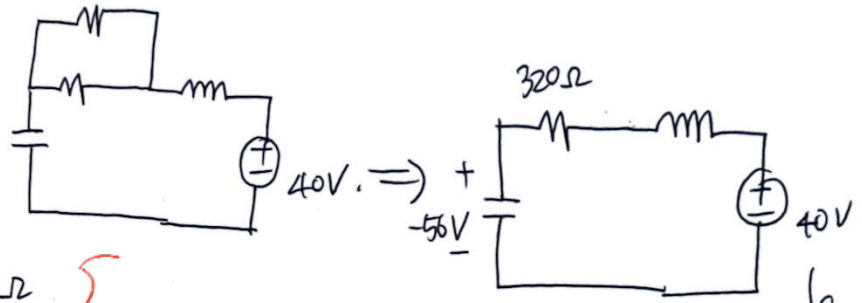
Question Number: 7

$t<0$.



$V_0(0) = -56\,V$

$t \geq 0$



$R = 320\,\Omega$

$L = 0.5 \cdot 10^{-3}\,H$

$C = 12.5 \cdot 10^{-9}\,F$.

계산 Step.

$V_C(\infty) = 40\,V$

$V_C(0) = -56\,V$.

$$\alpha = \frac{R}{2L} = \frac{320}{2 \cdot 0.5 \cdot 10^{-3}} = 320000$$

$$\omega_0^2 = \frac{1}{LC} = \frac{1}{0.5 \times 12.5 \times 10^{-12}} = 1.6 \times 10^{11} = 400000^2.$$

$\omega_0^2 - \alpha^2 > 0$. underdamped!

$\omega_d = 240000$. $\alpha = 320000$.

$$V_C(t) = 40 + B_1' e^{-320000t} \cos 240000t + B_2' e^{-320000t} \sin 240000t.$$

$V_C(0) = 40 + B_1' = -56$ $\quad B_1' = -96\,V$.

$$\frac{dV_C(0+)}{dt} = \frac{I_C}{C} = -320000 B_1' + 240000 B_2' = 0.$$

$$B_2' = \frac{320000}{240000} B_1' = -128.$$

$\therefore V_0(t) = 40 - 96 e^{-320000t} \cos 240000t - 128 e^{-320000t} \sin 240000t$

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