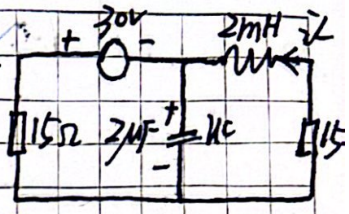
日期: 5.20 / 主题: 第5章作业

5-4 稳态中：电感相当于短路，电容相当于断路



$i_L = \frac{30}{15+15} = 1A$　　$E_L = \frac{1}{2}L \cdot i_L^2 = 1mJ$

$u_C = -15V$　　$E_C = \frac{1}{2}C \cdot u_C^2 = 1.125\times10^{-4}J$

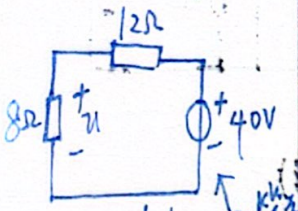
225μJ

5-6 $u_C(0^+) = u_C(0^-) = 40V$

换路后 $R_{eq} = 8+12 = 20\Omega$　　$\tau = R_{eq} \cdot C = 40\mu s = 4\times10^{-5}s$

$\therefore u_C(t) = 40e^{-4\times10^5 t}$　　$i_C(t) = C\cdot\frac{du_C(t)}{dt} = 2\times10^{-5}\cdot(-1.6)\times10^{5}e^{-4\times10^5 t} = -3.2\times10^{-2}\cdot e^{-4\times10^5 t}$

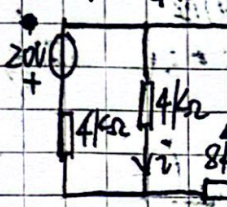
$u(t) = -8i_C(t) = 2.56\times10^{-3}\cdot e^{-4\times10^5 t}$　　$u(0^+) = u(0) = 2.56\times10^{-3}V$



$u(0^+) = 16V$　电容等效

5-7 换路前电感相当于导线，且 $i_L(0^+) = i_L(0^-)$，根据电阻串并联

$R_{并} = \frac{4\times8}{4+8} = \frac{8}{3}k\Omega$　　$i_L(0^+) = \frac{20V}{4k\Omega} = 5\times10^{-3}A$



$i_C = \frac{20V}{(4+R_{并})k\Omega}$　　$R_{并} = \frac{4\times8}{4+8} = \frac{8}{3}$　　$\therefore i_C = 3mA$

$u_{OC} = \frac{4}{4+4}\times20 = 10V$　　$\therefore R_{eq} = \frac{u_{OC}}{i_{SC}} = \frac{10}{3}\times10^3$

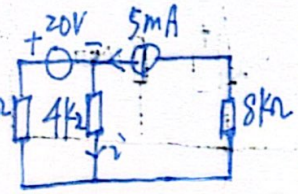
$\tau = \frac{L}{R_{eq}} = 2.1\times10^{-3}s$

$\therefore i_L(t) = (5\times10^{-3} - 3\times10^{-3})e^{-\frac{10}{21}\times10^3 t} + 3\times10^{-3}$

$= 2\times10^{-3}e^{-\frac{10}{21}\times10^3 t} + 3\times10^{-3}$

$u_L(t) = L\frac{di_L(t)}{dt} = 7\times10^{-3}\cdot2\times10^{-3}\cdot(-\frac{10}{21}\times10^3)e^{-\frac{10}{21}\times10^3 t}$

$= \frac{20}{3}\times10^{-3}e^{-\frac{10}{21}\times10^3 t}$



$i(0^+) = 0A$

求 $i(0^+)$ / $u(0^+)$ =

电容 → ○ →

电感 → | | →

注意方向

$u_L(t) = -8\times10^3 i_L(t) - 4\times10^3 i(t)$

$\therefore i(t) = \frac{\frac{20}{3}\times10^{-3}e^{-\frac{10}{21}\times10^3 t} + (-16e^{-\frac{10}{21}\times10^3 t} - 24)}{-4\times10^3}$

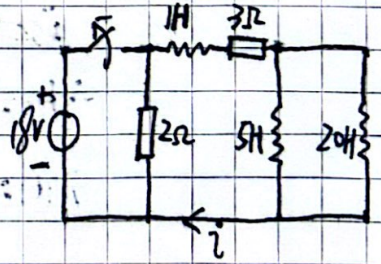
$i(0^+) = i(0) = (-\frac{5}{3}\times10^{-6} + 10^{-2})A$

6-4 总电感 $L = \frac{20\times5}{20+5} + 1 = 5H$

$i(0^+) = i(0^-) = 6A$　换路后无输入

∴响应是零输入响应

$\tau = \frac{L}{R} = \frac{5H}{5R} = 1s$



总结：

$\therefore i_L(t) = i(0^+)\cdot e^{-\frac{t}{\tau}} = 6\cdot e^{-t}$

$\therefore i(t) = 6e^{-t}A$　$t>0$

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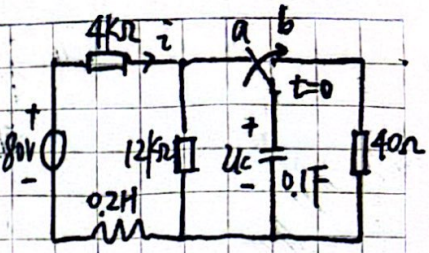
6-5 $u_C(0^+)=u_C(0^-)=80\times\frac{12}{12+4}=60V$

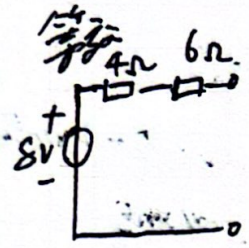
$\tau=RC=4s$

$\therefore u_C(t)=60\cdot e^{-\frac{1}{4}t}V \quad t\geq 0$

是零输入响应



等效



6-6 $u_C(0^+)=u_C(0^-)=0$ 是零状态响应

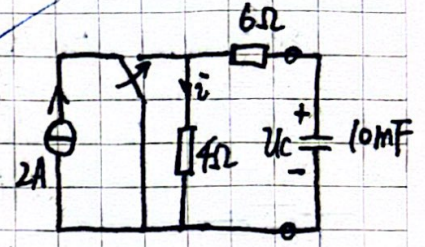
$u_{OC}=8V \quad R_{eq}=10\Omega$

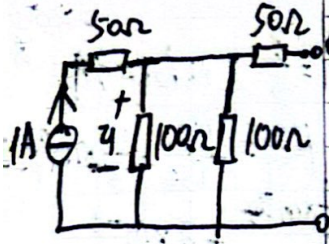
$\therefore \tau=RC=0.1s$

$\therefore u_C(t)=(1-e^{-10t})\cdot 8\ (V) \quad t\geq 0$

$i_C(t)=C\frac{du_C(t)}{dt}=10^{-2}\cdot 80\cdot e^{-10t}=0.8\cdot e^{-10t}\ (A)$

并联用KCL: $i=i_C(t)+2=0.8e^{-10t}+2\ (A)$





6-7 $i_L(0^+)=i_L(0^-)=0$ 是零状态响应

$u_{OC}=u_{100\Omega}=0.1A\times\frac{100}{100+100}\times 100=5V$

$i_{SC}=0.05A$

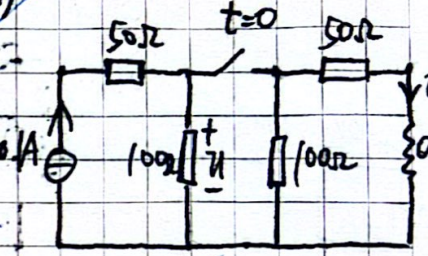
$\therefore R=\frac{u_{OC}}{i_{SC}}=100\Omega \quad \tau=\frac{L}{R}=\frac{1}{10005}$

$i_L(t)=(1-e^{-1000t})\cdot\frac{5}{100}=0.05(1-e^{-1000t})$

$u_L(t)=L\frac{di_L(t)}{dt}=5e^{-1000t} \quad u=i_L(t)\cdot R=50\cdot 0.05(1e^{-1000t})$

$=2.5(1-e^{-1000t})$

$\therefore u(t)=u_L(t)+u=2.5(1+e^{-1000t})$



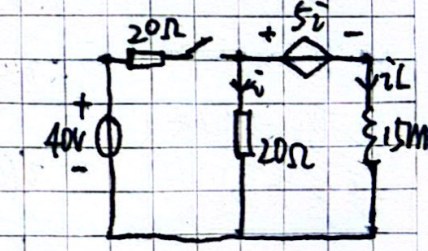
6-8 $i_L(0^+)=i_L(0^-)=0$

$u_{OC}=15V$

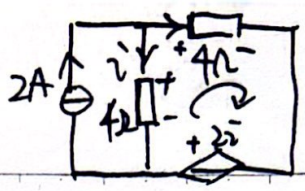
$\therefore i_{SC}=2A$

$\therefore R_{eq}=\frac{u_{OC}}{i_{SC}}=7.5\Omega \quad \tau=\frac{L}{R}=\frac{1}{5000}s$

$i_L(t)=(1-e^{-5000t})\cdot 2$



总结:



$\varphi(2-i)-\varphi i=2i$

Date. $i=0.8A \Rightarrow i_{SC}=1.2A$

6.9 $u_C(0^+)=u_C(0^-)=9V$

$u_{OC}=2\times4+2\times2=12V$

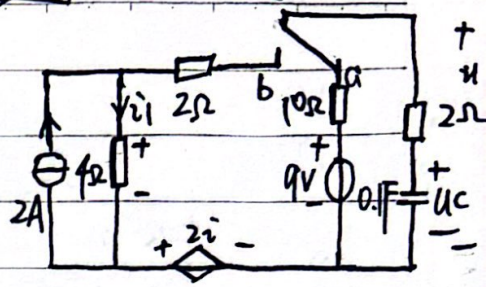
$i_{SC}=\frac{12}{2}=6A$

$R=\frac{u_{OC}}{i_{SC}}=2\Omega$ $\quad\therefore\tau=RC=0.2s$

$\therefore u_C(t)=(9-12)e^{-\frac{1}{0.2}t}+12=-3e^{-5t}+12$

$i_C(t)=C\cdot\frac{du_C(t)}{dt}=0.1(15e^{-5t})=1.5e^{-5t}$ 0.3 e^{-t}

$\therefore u(t)=i_C(t)\cdot2+u_C(t)=3e^{-5t}+(12-3e^{-5t})=12$ 0.6



全响应 $-2\cdot9e^{-1.25t}$

?

6.11 $u_C(0^+)=u_C(0^-)=6V$ 0.8s

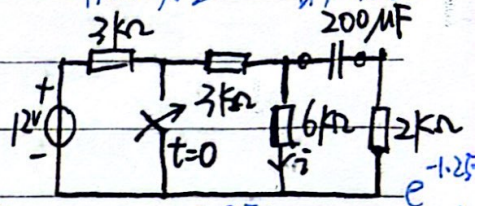
$R_{eq}=\frac{3\times6}{3+6}+2=4\Omega$ $\quad\therefore\tau=RC=8\times10^{-6}s$

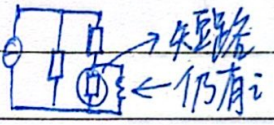
$u_C(t)=6\cdot e^{-8\times10^6t}$ $\quad6\cdot e^{-1.25t}$

$i_C(t)=C\frac{du_C(t)}{dt}=-96e^{-8\times10^6t}$ $\quad i_C(t)=2\times10^{-6}\cdot6\cdot(-1.25)e^{-1.25t}=-1.5\times10^{-3}e^{-1.25t}$

$\therefore i=\frac{3}{3+6}\cdot i_C(t)=-32e^{-8\times10^6t}$ $\quad-0.5\times10^{-3}e^{-1.25t}$

稳态分量 暂态分量





6.12 $i_L(0^+)=i_L(0^-)=0A$ 1A

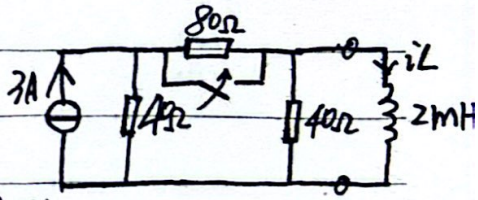
$u_{OC}=3\times\frac{40}{40+40}\times40=60V$

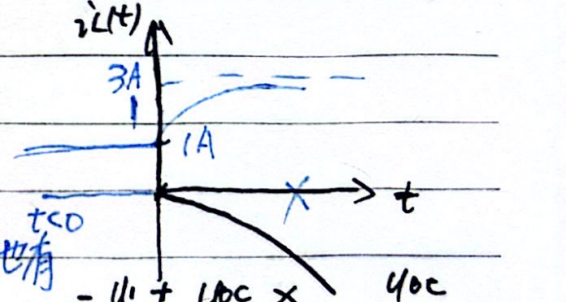
$i_{SC}=3A$

$\therefore R_{eq}=\frac{u_{OC}}{i_{SC}}=20\Omega$ $\quad\therefore\tau=\frac{L}{R_{eq}}=10^{-6}s$

$\therefore i_L(t)=(1-e^{10^6t})\cdot3A$

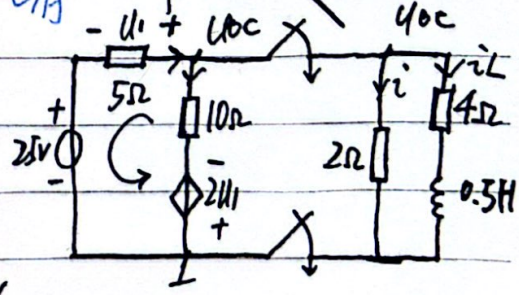
$3+[1-3]e^{10^6t}=3-2e^{10^6t}$





6.13 $i_L(0^+)=i_L(0^-)=0A$

求 u_{OC}: $\begin{cases}\left(\frac{1}{5}+\frac{1}{10}+\frac{1}{2}\right)u_{OC}=5A-\frac{2u_1}{10}A\\ u_{OC}=u_1+25\end{cases}$ $\quad\therefore u_{OC}=10AV$ $\quad u_1=-15V$



求 i_{SC}: $\begin{cases}\left(\frac{1}{5}+\frac{1}{10}+\frac{1}{2}+\frac{1}{4}\right)u_a=\left(5-\frac{2u_1}{10}\right)A\\ u_a=u_1+25\end{cases}$ $\quad\therefore u_1=7V$ $\quad\therefore i_{SC}=\frac{8}{4}=2A$ $\quad u_a=8V$

$R_{eq}=\frac{u_{OC}}{i_{SC}}=5\Omega$

$-2e^{-10t}+2$

$i_L(t)=$ $\quad u_L(t)=L\frac{di_L(t)}{dt}=10e^{-10t}$ $\quad\therefore i(t)=e^{-10t}+\varphi$

$\tau=\frac{L}{R}=0.1s$