不要求：8.5，8.6.4

第8章作业

[8-21] (1) 令 $U_S=\varepsilon(t)$ $R_{eq}=22.5\Omega+10\Omega=32.5\Omega$

知 $U_C(0_+)=U_C(0_-)=0$ $\tau=R_{eq}C=0.65s$

$U_C(\infty)=\frac{3}{4}$

∴ $U_C=U_C(\infty)+[U(0_+)-U(\infty)]e^{-\frac{t}{0.65}}$

$=\frac{3}{4}(1-e^{-\frac{t}{0.65}})\varepsilon(t)V$

(2) 求导: $h(t)=\frac{ds(t)}{dt}=\frac{15}{13}e^{-\frac{t}{0.65}}\varepsilon(t)+\frac{3}{4}(1-e^{-\frac{t}{0.65}})\delta(t)$

$=\frac{15}{13}e^{-\frac{t}{0.65}}\varepsilon(t)V$

(3) $i_C(0)=\frac{9}{10}\cdot\frac{1}{39}\delta(t)A$ (?)

$U_C(0_+)=U_C(0_-)+\frac{1}{C}\int_{0_-}^{0_+}i_C(0)dt$

$=0+\frac{3}{0.02\times10\times13}\int_{0_-}^{0_+}\delta(t)dt=\frac{15}{13}V$

∴ $h(t)=\frac{15}{13}e^{-\frac{t}{0.65}}\varepsilon(t)V$

[8-22] (1) 令 $U_S=\varepsilon(t)$

$i_L(0_+)=i_L(0_-)=0$

$i_L(\infty)=\frac{1}{4+4}\times\frac{2}{3}=\frac{1}{12}A$

$R_{eq}=(12\Omega//4\Omega)+6\Omega=9\Omega$

$\tau=\frac{L}{R_{eq}}=\frac{1}{45}s$

∴ $i_L=i_L(\infty)+[i_L(0_+)-i_L(\infty)]e^{-45t}\varepsilon(t)$

$=\frac{1}{12}(1-e^{-45t})\varepsilon(t)A$

(2) $h(t)=\frac{ds(t)}{dt}=\frac{15}{4}e^{-45t}\varepsilon(t)A$

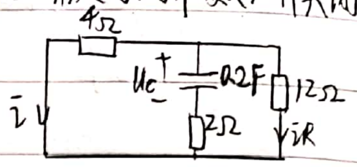
(3) 令 $U_S=\delta(t)$ 则 $U_L(0)=\frac{3}{4}\delta(t)$

$i_L(0_+)=i_L(0_-)+\frac{1}{L}\int_{0_-}^{0_+}U_L(0)dt$

$=\frac{15}{4}\int_{0_-}^{0_+}\delta(t)dt=\frac{15}{4}$

∴ $h(t)=\frac{15}{4}e^{-45t}\varepsilon(t)A$

[8-2] ①确定时间常数，开关闭合后：



$R_{eq}=(4\Omega//12\Omega)+2\Omega=5\Omega$

$\tau=CR_{eq}=1s$

② $t<0$时，$U_C(0_-)=\frac{12}{12+8+4}\times24V=12V$

$U_C(0_+)=U_C(0_-)=12V$

∴ $U_C=12e^{-t}V$

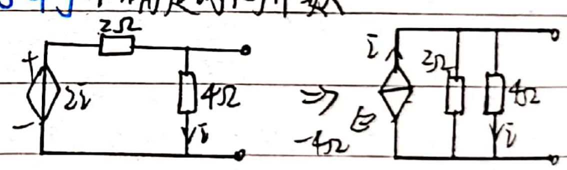
$i'=\frac{U_C}{(4//12)+2}\times\frac{12}{4+12}A=1.8e^{-t}A$

$i_R=\frac{U_C}{(4//12)+2}\times\frac{4}{4+12}A=0.6e^{-t}A$

$i''=\frac{24V}{8\Omega}=3A$ ←易漏!)

由叠加定理 $i=i'+i''=(3+1.8e^{-t})A$

[8-4] 1.确定时间常数



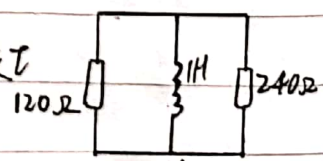
∴ $R_{eq}=2\Omega$

$\tau=R_{eq}C=1s$

② $U_C(0_+)=U_C(0_-)=10V$ ∴ $U_C=10e^{-t}V$

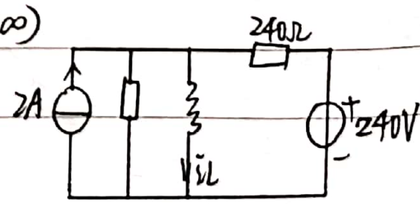
$i=\frac{1}{2}\frac{U_C}{R_{eq}}=2.5e^{-t}A$

[8-13] ①确定τ



∴ $R_{eq}=80\Omega$ $\tau=\frac{L}{R_{eq}}=\frac{1}{80}s$

②确定 $i_L(\infty)$



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第8章作业

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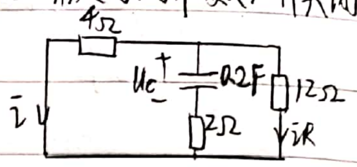
[8-2] ① 确定时间常数，开关闭合后，



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$i''=\frac{24V}{8\Omega}=3A$ ←易漏！

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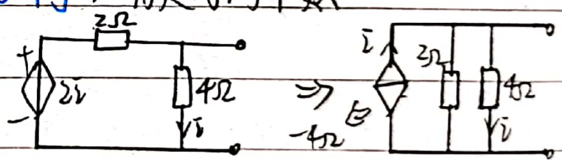
[8-4] 1.确定时间常数



∴ $R_{eq}=2\Omega$

$\tau=R_{eq}C=1s$

② $U_C(0_+)=U_C(0_-)=10V$ ∴ $U_C=10e^{-t}V$

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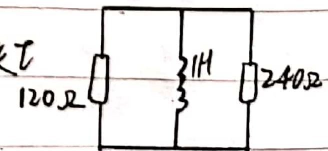
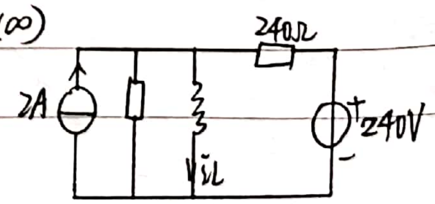
[8-13] ① 确定τ



∴ $R_{eq}=80\Omega$ 　$\tau=\frac{L}{R_{eq}}=\frac{1}{80}s$

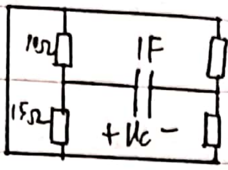
② 确定 $i_L(\infty)$



由叠加定理 $i_L(\infty)=2A+\frac{240V}{240\Omega}=3A$

$\therefore i_L=3(1-e^{-80t})A$

[8-18] ① 确定时间常数.



$R_{eq}=(10\Omega//15\Omega)+(32\Omega//8\Omega)$

$=12.4\Omega$ $\therefore \tau=R_{eq}C=12.4s$

② $u_C(0_+)=u_C(0_-)=0$

③ 稳态: $u_C(\infty)=\frac{20}{25//40}\times(-\frac{8}{13}\times 10+\frac{5}{13}\times 32)=8V$

$\therefore u_C=8(1-e^{-\frac{5t}{62}})\varepsilon(t)V$

[8-31] $C=2F$ 时, 时间常数 $\tau=R_{eq}C=4s$

$\therefore$ 从电容元件两端看进去的等效电阻 $R_{eq}=2\Omega$

$\therefore$ 电容换成电感时 R_{eq} 不变

$\tau'=\frac{L}{R_{eq}}=\frac12 s$

接电容时, $u_0(0_+)=\frac58V$, $u_0(\infty)=\frac12V$

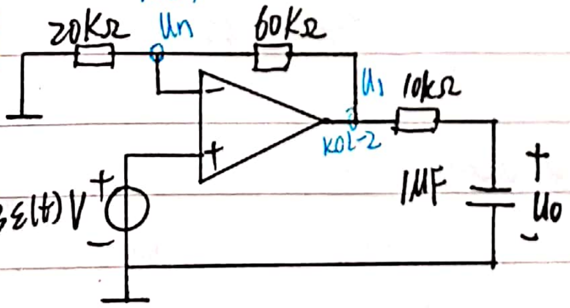
达稳态时,电容相当于断路,电流为0,相当于电感刚接入,电流为0的状态 $\therefore u_0'(0_+)=\frac12V$

电容刚接入时其两端电压为0相当于被短路,即电感接入达稳态的情况 $\therefore u_0'(\infty)=\frac58V$

$\therefore u_0'=u_0'(\infty)+[u_0'(0_+)-u_0'(\infty)]e^{-\frac{t}{\tau}}$

$=(\frac58-\frac18e^{-t})\varepsilon(t)$ V

[8-37]



KCL-1: $\frac{u_n}{20k}+\frac{u_n-u_1}{60k}=0$ 又 $u_n=u_p=3\varepsilon(t)V$

KCL-2: $\frac{u_1-u_0}{10k}=1\times10^{-6}\frac{du_0}{dt}$

$\therefore \frac{du_0}{dt}+100u_0=1200$

特征方程 $s+100=0$ $\therefore s=-100$ 特解 $y_h=\frac{1200}{100}=12$

$\therefore u_0=12(1-e^{-100t})\varepsilon(t)V$

(2) $\because u_1=12\varepsilon(t)V$ $\therefore |U_{CC}|\geq 12V$

[8-41] ① 令 $u_S=\varepsilon(t)V$ 则 $u_C=s(t)$ 单位阶跃响应

② 单位冲激响应 $h(t)=\frac{ds(t)}{dt}=e^{-t}\varepsilon(t)V$

$u_C=(1-e^{-t})\varepsilon(t)V$ $i_C=C\frac{du_C}{dt}=e^{-t}\varepsilon(t)A$

当 $u_S=-(t-1)[\varepsilon(t)-\varepsilon(t-1)]V$ 时,

$u_C=\int_{0_-}^{t}u_C(\tau)h(t-\tau)d\tau$

$=\int_{0_-}^{t}-(\tau-1)[\varepsilon(\tau)-\varepsilon(\tau-1)]e^{-(t-\tau)}\varepsilon(t-\tau)d\tau$

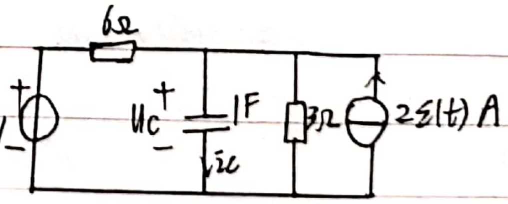
$=\int_{0_-}^{t}-(\tau-1)e^{-(t-\tau)}\varepsilon(\tau)\varepsilon(t-\tau)d\tau-\int_{0_-}^{t}-(\tau-1)e^{-(t-\tau)}\varepsilon(\tau-1)\varepsilon(t-\tau)d\tau$

$=[\int_{0}^{t}-(\tau-1)e^{-(t-\tau)}d\tau]\varepsilon(t)-[\int_{1}^{t}-(\tau-1)e^{-(t-\tau)}d\tau]\varepsilon(t-1)$

$=(-2e^{-t}-t+2)\varepsilon(t)-[-e^{-(t-1)}+(1-t)+1]\varepsilon(t-1)V$

$i_C=C\frac{du_C}{dt}=[(2e^{-t}-1)\varepsilon(t)+(-e^{-(t-1)}+1)\varepsilon(t-1)]A$

[8-48]



$R_{eq}=6\Omega//3\Omega=2\Omega$ $\tau=CR_{eq}=2s$

知 $u_C(0_-)=0$, $u_C(\infty)=2\times\frac{6\times3}{6+3}=4V$

$i_C(0)=\frac13\delta(t)$

$u_C(0_+)=u_C(0_-)+\frac1C\int_{0_-}^{0_+}i_C(0)dt=\frac13\varepsilon(t)V$

$\therefore u_C=u_C(\infty)+[u_C(0_+)-u_C(\infty)]e^{-\frac{t}{2}}=(4-\frac{11}{3}e^{-\frac{t}{2}})\varepsilon(t)V$

~~t>0时~~, $i_C=C\frac{du_C}{dt}=[\frac{11}{6}e^{-\frac{t}{2}}\varepsilon(t)+\frac13\delta(t)]A$

[8-42] ① $\tau=RC=1s$. 令 $i_s=\varepsilon(t)$ A

则 $u_C=\cancel{\varepsilon(t)}(1-e^{-t})\varepsilon(t)$ V $=s(t)$

② $h(t)=\frac{ds(t)}{dt}=e^{-t}\varepsilon(t)$ V

③ $i_s=\sin t[\varepsilon(t)-\varepsilon(t-\pi)]$ A

④ $u_C=\int_0^t u_C(\tau)h(t-\tau)d\tau$

$=\int_0^t \sin\tau[\varepsilon(\tau)-\varepsilon(\tau-\pi)]e^{-(t-\tau)}\varepsilon(t-\tau)d\tau$

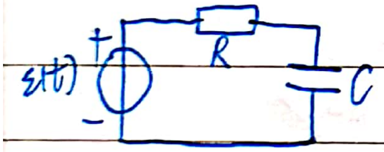
$=[\int_0^t \sin\tau e^{-(t-\tau)}d\tau]\varepsilon(t)$

$-[\int_\pi^t \sin\tau e^{-(t-\tau)}d\tau]\varepsilon(t-\pi)$

$=\left(\frac{(\sin t-\cos t)+e^{-t}}{2}\varepsilon(t)-\frac{(\sin t-\cos t)-e^{-(t-\pi)}}{2}\varepsilon(t-\pi)\right)$ V

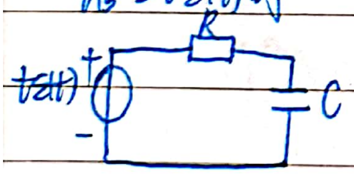
[8-41] 法2：叠加定理

$u_C=\varepsilon(t)(1-e^{-t})$V 时，电路等效



其中 $RC=\tau=1$

$u_s=t\varepsilon(t)$ 时



$t>0$ 时

$C\frac{du_C}{dt}R+u_C=t$

$\Rightarrow u_C=t+e^{-t}$

$\Rightarrow i=C\frac{du_C}{dt}=1-e^{-t}$

$\therefore u_s=(1-t)[\varepsilon(t)-\varepsilon(t-1)]$

$=\varepsilon(t)-t\varepsilon(t)+(t-1)\varepsilon(t-1)$ 时

$i=e^{-t}\varepsilon(t)-(1-e^{-t})\varepsilon(t)+(1-e^{-(t-1)})\varepsilon(t-1)$

$=(2e^{-t}-1)\varepsilon(t)+(1-e^{-(t-1)})\varepsilon(t-1)$

[8-44] $s(t)=0.5e^{-2t}\varepsilon(t)$

$h(t)=\frac{ds(t)}{dt}=-e^{-2t}\varepsilon(t)+0.5e^{-2t}\delta(t)$

$=-e^{-2t}\varepsilon(t)+0.5\delta(t)$

$u_s=2e^{-2t}\varepsilon(t)$ V时

$u_o=\int_{0_-}^t u_s(\tau)h(t-\tau)d\tau$

$=\int_{0_-}^t 2e^{-2\tau}\varepsilon(\tau)[-e^{-2(t-\tau)}+0.5\delta(\tau)]d\tau$

$=[\int_0^t -2e^{-2\tau}e^{-2(t-\tau)}d\tau]\varepsilon(t)+\int_0^t 2e^{-2\tau}\cdot 0.5\delta(\tau)d\tau$

$=-2te^{-2t}\varepsilon(t)-0.5(e^{-2t}-1)\varepsilon(t)$

$te^{-2t}\varepsilon(t)$ V

[8-46] $R_{eq}=40\Omega$ $\tau=\frac{L}{R_{eq}}=\frac{1}{40}s$

$i_L(0)=\frac{1}{32}\times\frac{2}{5}=\frac{1}{80}A$

$\therefore i_L=\frac{1}{80}e^{-40t}\varepsilon(t)$ A

冲激响应计算：

$u_C(0_+)=u_C(0_-)+\frac{1}{C}\int_{0_-}^{0_+}i_C(0)dt$

将电容视为短路求 $i_C(0)$，表达式中含 $\delta(t)$

$\Rightarrow$ step1. C→求 $i_C(0)$ L→求 $u_L(0)$

2. $i_C(0)\to u_C(0_+)$, $u_L(0)\to i_L(0_+)$

$u_L(0)=0.5\delta(t)$ V, $i_L(0_-)=0$

$i_L(0_+)=i_L(0_-)+\frac{1}{L}\int_{0_-}^{0_+}u_L(0)dt=0.5\varepsilon(t)$ A

$R_{eq}=40\Omega$. $\tau=\frac{L}{R_{eq}}=\frac{1}{40}s$. $i_L(\infty)=0$

$\therefore i_L=0.5e^{-40t}\varepsilon(t)$ A

$\Rightarrow$ 若令 $u_s=\varepsilon(t)$ V

则 $i_L(0_+)=i_L(0_-)=0$, $i_L(\infty)=\frac{1}{80}$A

$s(t)=i_L=\frac{1}{80}(1-e^{-40t})\varepsilon(t)$ A

$h(t)=\frac{ds(t)}{dt}=0.5e^{-40t}\varepsilon(t)$ A

$\therefore U_{o2} = (2.4 + 2.12e^{-1.25\times10^5(t-3\times10^{-6})})V \quad (t>3\mu s)$

[8-57] $\tau = RC = 10^{-2}s = 10ms \quad 5\tau > T$

$U_1 = \frac{1}{1+e^{-\frac{T}{\tau}}}U_S = 7.3V$

$U_2 = \frac{e^{-\frac{T}{\tau}}}{1+e^{-\frac{T}{\tau}}}U_S = 2.7V$

$\therefore u_0 = \begin{cases}(10-7.31e^{-100t})V, & 0<t<0.01s \\ 7.31e^{-100(t-0.01)}V, & 0.01s<t<0.02s\end{cases}$

[8-58] (1) $\frac{u_{01}}{25k} + \frac{u_0}{100k} + 1\times10^{-6}\frac{du_0}{dt} = 0$ ①

$\therefore 40u_{01} + 10u_0 + \frac{du_0}{dt} = 0$

② $\frac{u_S}{100k} + \frac{u_{01}}{500k} + 1\times10^{-7}\frac{du_{01}}{dt} = 0$

$\therefore 100u_S + 20u_{01} + \frac{du_{01}}{dt} = 0$

$u_S = 250mV \quad \therefore \frac{du_{01}}{dt} + 20u_{01} + 25 = 0$

$u_{01} = (1.25e^{-20t} - 1.25)V$

$\therefore 50e^{-20t} - 50 + 10u_0 + \frac{du_0}{dt} = 0$

$y' + 10y = -50e^{-20t} + 50$

~~$y_{h1}=5,\ y_{h2}$~~

$y = e^{\int 10dt}\left(\int(-50e^{-20t}+50)e^{\int 10dt}dt + c\right)$

$= e^{-10t}\left(50\int(-e^{-10t}+e^{10t})dt + c\right)$

$= e^{-10t}(5e^{-10t} + 5e^{10t} + c)$

$= 5e^{-20t} + ce^{-10t} + 5$

又 $u_0(0)=0 \quad \therefore u_0 = (5e^{-20t} - 10e^{-10t} + 5)V$

(2) $|U_S|_{max} \le 300mV$

[8-60](3) 右侧电容有跳变

$u_C(0_-) = -7i_L = -17.5V$

$u_C(0_+) + 5i_L(0_+) = 0 \quad \therefore u_C(0_+) = -12.5V$

$-12.5 = -17.5 - \frac{1}{2}\int_{0_-}^{0_+} i(0)\,dt \quad \therefore i(0) = -10\delta(t)$

考试考不到
这个难度

[8-59] (1) $\tau = R_{ab}C = 0.1 \quad \therefore R_{ab} = 10^5\Omega$

(2) $u_0(0_-) = u_0(0_+) = 5V$

(3) 将U_S置零 则仅在i_S作用下

$u_0(0_+) - u_0(\infty) = -8V$ 又 $u_0(0_+) = 5V$

$\therefore u_0(\infty) = 13V \quad \therefore K = u_0(\infty) = 13$

(4) 知i_S单独作用时, $u_{01}(\infty) = 13V$

又U_S, i_S共同作用时 $u_0(\infty) = 20V$

$\therefore U_S$单独作用时, $u_{02}(\infty) = 7V$

$\therefore u_0 = (7 - 2e^{-10t})V$

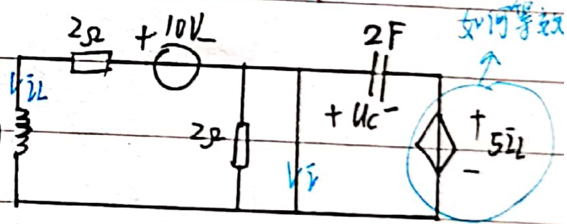
(5) $W = \frac{1}{2}Cu^2 \quad \therefore u_0'(0_+) = \sqrt{2}u_0(0_+) = 5\sqrt{2}V$

$u_0'(\infty) = 7V - 13V\times2 = -19V$ $-6V$ 这里不用×2

$\therefore u_0' = [-19 + (5\sqrt{2}+19)e^{-10t}]V$ → 题意: u_0' 变为原来的二倍

$(-6+16e^{-10t})V$?

[8-60]



电容电感在两个独立回路

(1) $t<0$时, $i_L = \frac{10V}{4\Omega} = 2.5A$. $u_C + 5i_L = -2i_L$ $\therefore u_C = -17.5$

$i_L(0_+) = i_L(0_-) = 2.5A \quad u_C(0_+) = u_C(0_-) = -17.5V$

$t>0$时: L回路 $R_{eq} = 2\Omega$. $\tau_1 = \frac{L}{R_{eq}} = 1s \quad i_L(\infty) = \frac{10V}{2\Omega} = 5A$

$\therefore i_L = (5 - 2.5e^{-t})A \ (t>0)$

(2) C回路 $u_C + 5i_L = 0$

$i = -(i_L + C\frac{du_C}{dt}) = -(i_L + 2\frac{d(-5i_L)}{dt})$

$= 2.5e^{-t} - 5 + 10\times2.5e^{-t} = (27.5e^{-t} - 5)A$

(3) ~~$i(0) = 22.5A$~~ $-10\delta(t)A$?

~~$u_C = -5i_L = (12.5e^{-t} - 25)\varepsilon(t)$~~

~~$i_C = C\frac{du_C}{dt} = -25e^{-t}\varepsilon(t) + (25e^{-t} - 50)\delta(t)$~~