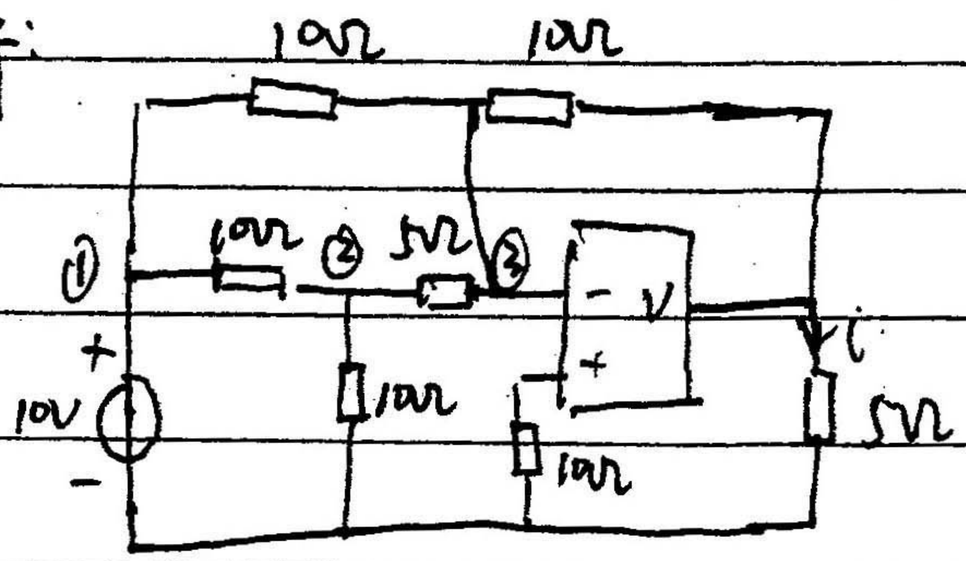
200x电路分析

一解：



设输出端对参考点电压为 U_0，$U_1=10V$，$U_3>0$

$$\begin{cases}(\frac{1}{10}+\frac{1}{10}+\frac{1}{5})U_2-\frac{1}{10}U_1-\frac{1}{5}U_3=0 \\ (\frac{1}{5}+\frac{1}{10}+\frac{1}{10})U_3-\frac{1}{5}U_2-\frac{1}{10}U_1-\frac{1}{10}U_0=0\end{cases} \Rightarrow \begin{cases}U_0=-5V \\ I=\frac{U_0}{5}=3A\end{cases}$$

二解：进行△-Y等效，$Z_L'=\frac{1}{3}Z_L=(6+j6)\Omega$，$\dot{U}_A=220\angle-30°V$

得 $\dot{I}_A=\frac{\dot{U}_A}{Z_L+Z_L'}=22\angle-67°A$

$\therefore \dot{I}_{A'B'}=\frac{22}{\sqrt{3}}\angle-37°A$ 计算 $P=3\times(\frac{22}{\sqrt{3}})^2\times18W=7.2kW$

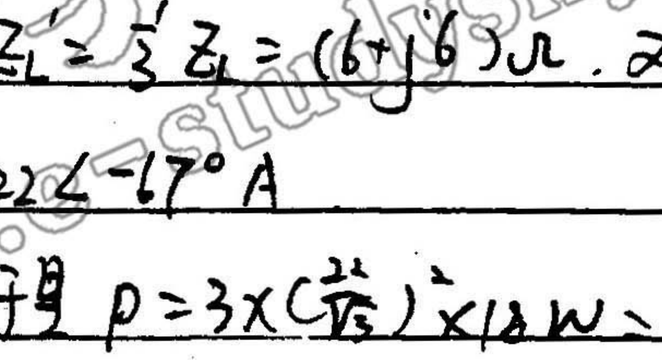
$Q=3\times(\frac{22}{\sqrt{3}})^2\times18Var=8.7kVar$

$S=\sqrt{P^2+Q^2}=11.232kVA$ 又 $\dot{I}_B=22\angle-67°A$，$\therefore \dot{U}_{A'B'}=380\angle0°+\dot{I}_BZ_L-\dot{I}_AZ_L$

$=322\angle8°V$

三解① U_0单独作用时 $I_0=-\frac{U_0}{R}=-\frac{5V}{1\Omega}=-5A$

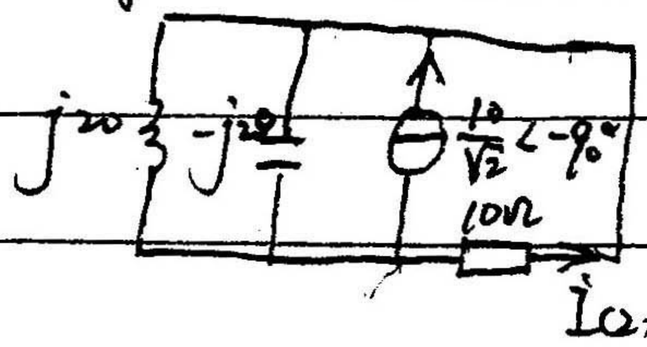
② U_S单独作用时



$\dot{I}_{(1)}=\frac{\frac{20°}{\sqrt{2}}\angle60°}{10+\frac{-j10\times10}{-j10}}=\frac{1}{\sqrt{2}}\angle7°$

$i_{(1)}=\sqrt{2}\cos(10t+7°)$

③ $\dot{U}_S$ 单独作用时



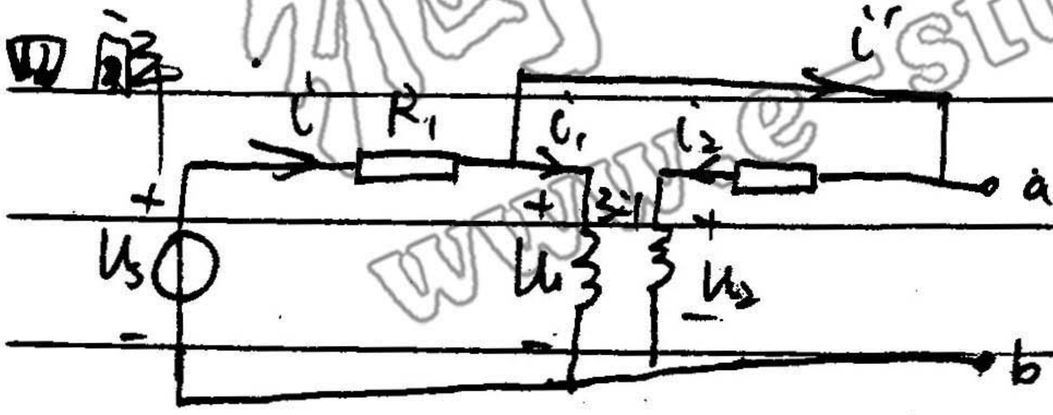
电路并联谐振情况，视为断路，$\dot{I}_{(3)} = -\frac{10}{\sqrt{2}}\angle -90°$

$\therefore i_{(3)} = -10\sin 20t$ A

$\therefore i = -5 + 12\cos(10t+7°) + 10\cos(20t+90°)$

$P_R = [(-5)^2 + (\frac{12}{\sqrt{2}})^2 + (\frac{10}{\sqrt{2}})^2] \times 10\,W = 1670\,W$

④ 原电路

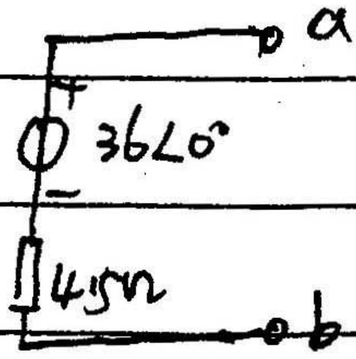


求 a、b 左端开路电压 U_{oc}，$\frac{\dot{U}_1}{\dot{U}_2} = 3$，$\frac{\dot{I}_1}{\dot{I}_2} = -\frac{1}{3}$

$$\begin{cases} \dot{U}_1 = (\frac{\dot{U}_S - \dot{U}_1}{R_1} - \dot{I}_1)R_2 + \dot{U}_2 \\ \dot{U}_1 = \dot{I}_2 R_2 + \dot{U}_2 \end{cases} \Rightarrow \begin{cases} \dot{U}_2 = 12\angle 0°\,V \\ \dot{I}_2 = 6\angle 0°\,A \\ \dot{U}_1 = 36\angle 0°\,V \end{cases}$$

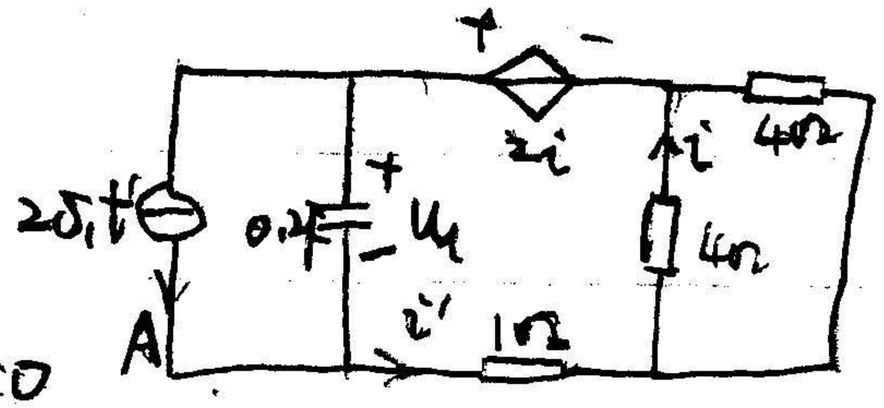
求 R_0，外加电源法，$R_0 = 4.5\,\Omega$

戴维南等效电路



$\therefore$ 1Ω 电流源单独作用时，等效电路如图所示。

通过1Ω的电流i'



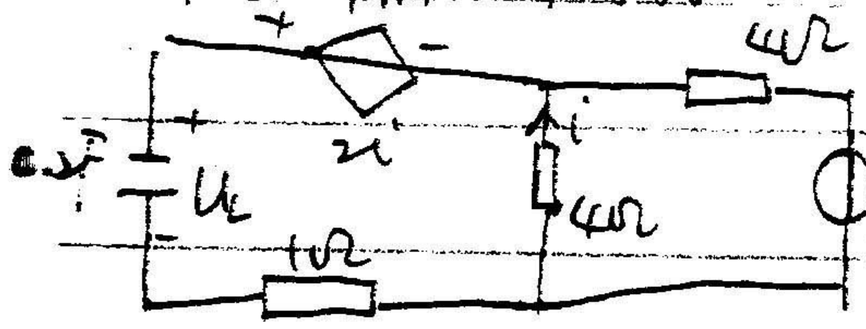
由KCL得 $20.1\frac{du_c}{dt}+C\cdot\frac{du_c}{dt}=i'$ ⑧

⇒ 积分得 $u_c(0+)=-10V$ $u_c(\infty)=0$

外加电源法求等效电阻 $R_0=2\Omega$ $\tau=R_0C=2\times0.25=0.5s$

$u_c(t)=-10e^{-2t}\varepsilon(t)$ V

2) 独电压源单独作用时

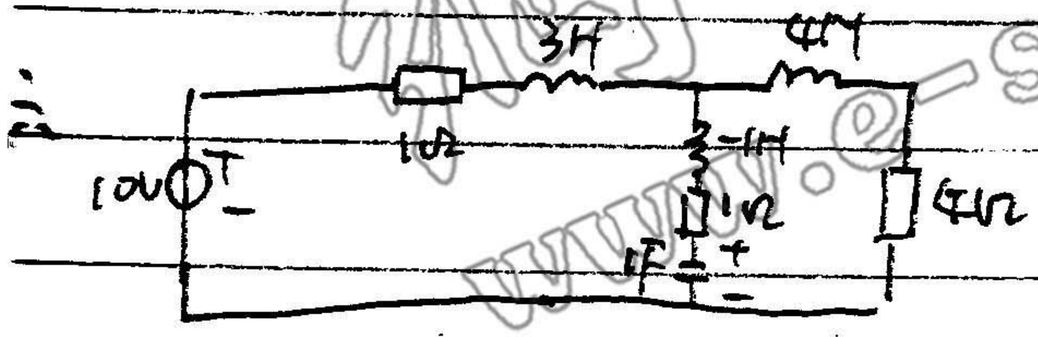


$i=-2A$ $u_c(\infty)=-2i$

$\therefore u_c(\infty)=4V$.

$R_0=2\Omega$ $\tau=0.5s$ $u_c(t)=(4e^{-2t})\varepsilon(t)$ V

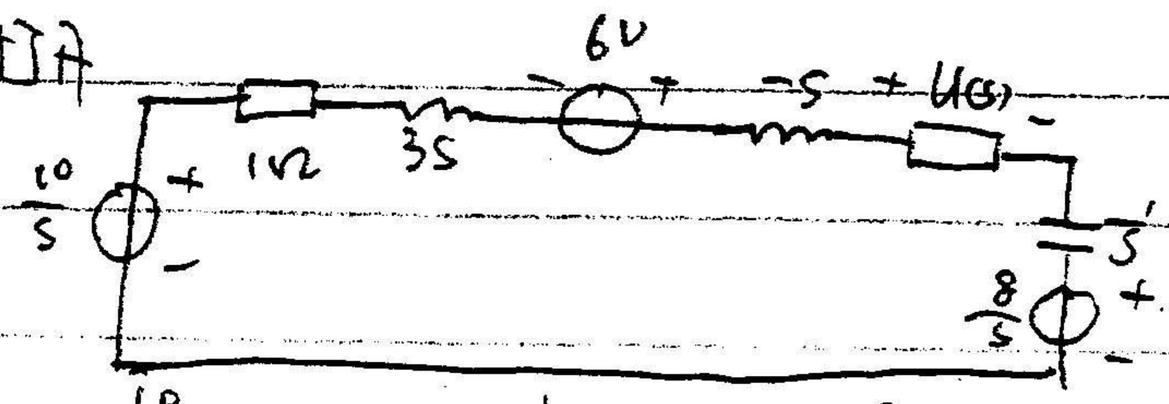
所以 $u_c(t)=(4-11e^{-2t})\varepsilon(t)$ V



$t<0$时 $i_{L_1}(0-)=i_{L_2}(0-)=\frac{10}{5}A=2A$

$u_c=4\times2V=8V$.

$t=0$时 K打开



设电流为I(s)，$\frac{10}{5}=(2+2s+\frac{1}{5})I(s)-6+\frac{8}{5}$

$\Rightarrow U(s)=\frac{2+6s}{2s^2+5s+1}\Rightarrow u(t)=\sqrt{10}e^{-2t}\cos(2t+\tan^{-1}\frac{1}{3})$

七解　以 u_c、i_L 为状态变量 $\begin{cases} C\dfrac{du_c}{dt}=i_1-i_L \quad L\dfrac{di_L}{dt}=u_c-R_2i_L \\ i_1=\dfrac{f(t)-u_c(t)}{R_1} \end{cases}$

$$\begin{bmatrix}\dot{u}_c\\ \dot{i}_L\end{bmatrix}=\begin{bmatrix}-\frac{1}{R_1C} & -\frac{1}{C}\\ \frac{1}{L} & -\frac{R_2}{L}\end{bmatrix}\begin{bmatrix}u_c\\ i_L\end{bmatrix}+\begin{bmatrix}\frac{1}{R_1C}\\ 0\end{bmatrix}f(t)$$

输出方程 $$\begin{bmatrix}i_1\\ i_c\end{bmatrix}=\begin{bmatrix}-\frac{1}{R_1} & 0\\ -\frac{1}{R_1} & -1\end{bmatrix}\begin{bmatrix}u_c\\ i_L\end{bmatrix}+\begin{bmatrix}\frac{1}{R_1}\\ \frac{1}{R_1}\end{bmatrix}f(t)$$

八 ① u负半轴时，$i=-1A$，$u=2\times1+(2+1)\times2=8V>0$，不成立

② u正半轴时，$u=i+1$（由图），$u=-2i+(2-i)\times2 \Rightarrow \begin{cases}u=1.6V\\ i=0.6A\end{cases}$　$u_1=2\times2+(2-i)\times2=6.8V$

九解：① $Z=\dfrac{20\times j\omega L}{20+j\omega L}-j\dfrac{1}{\omega C}=\dfrac{j20\times100L}{20+j100L}-j\dfrac{1}{100C}=10 \Rightarrow \begin{cases}L=0.2H\\ C=0.001F\end{cases}$

② $I_3=I_2+I_2\dfrac{R_1}{R_2}=I_2(1+\dfrac{R_1}{R_2})=1+\dfrac{R_1}{R_2}$

$U_s=R_1I_1+R_2(I_1-I_3)=4R_1+(4R_2-R_2-R_1)=3(R_1+R_2)$

断开后 $I_1=\dfrac{U_s}{R_1+R_2}=3A$

（02年完）