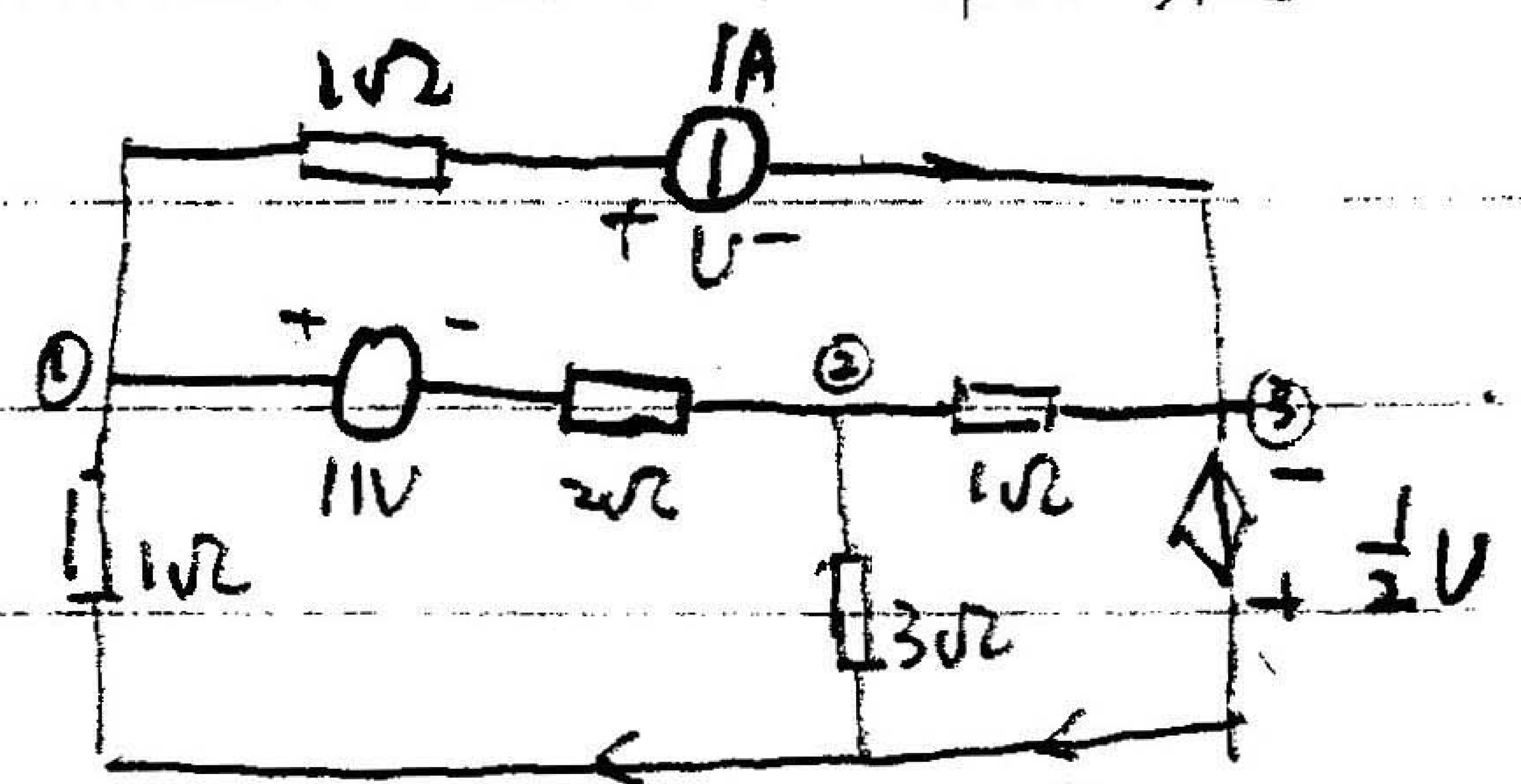
2000年答案

一、



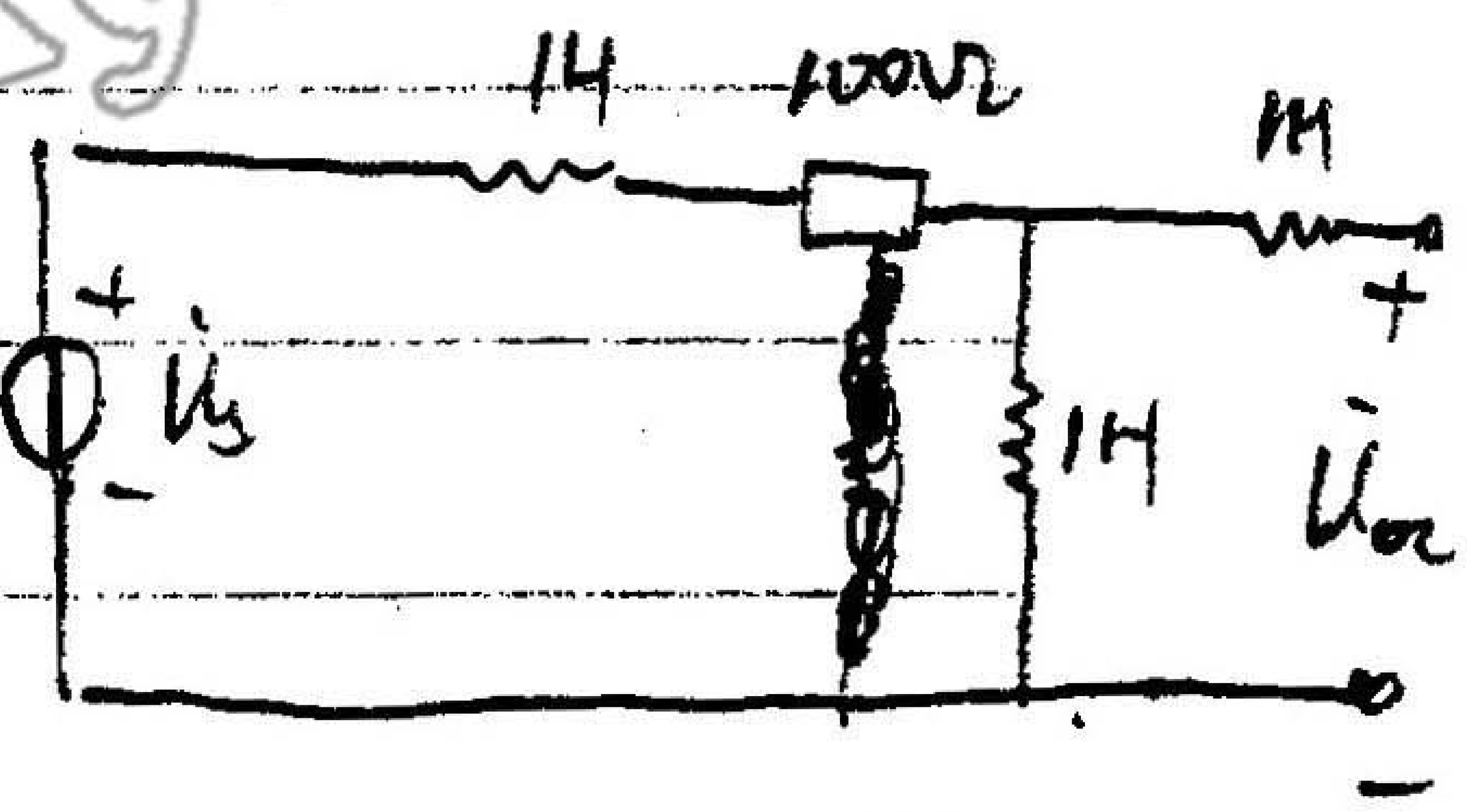
$$\begin{cases}(1+\frac{1}{2})U_1-\frac{1}{2}U_2=\frac{U}{2}-1\\ -\frac{1}{2}U_1+(\frac{1}{2}+\frac{1}{3}+1)U_2-U_3=-\frac{U}{2}\\ U_3=-\frac{1}{2}U\end{cases}$$

另 $U=U_1-U_3-1$

$\Rightarrow U_1=2V$ $\quad U_2=-3V$

故 $I_1=-\frac{U_1}{1}=-2A$，$I_2=I_1-\frac{U_2}{3}=-1A$

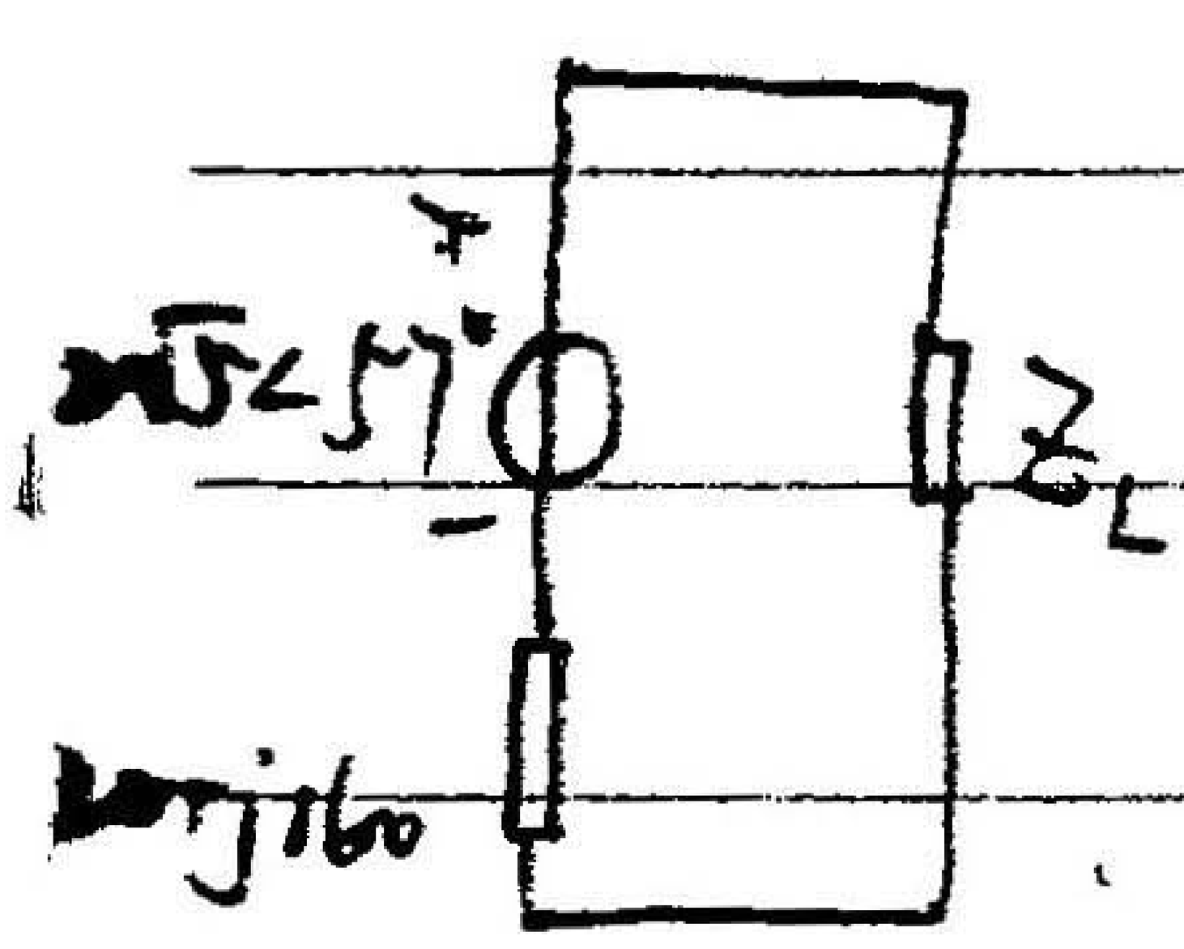
二 解 $\dot{U}_S=10\angle 30°$，求开路电压的电路（去耦）



$\dot{U}_{oc}=2\sqrt{5}\angle 57°$

用外加电流法求 R_{eq}，$R_{eq}=(20+j160)\Omega$

故戴维南等效电路



当 $Z_L=20-j160\Omega$ 获最大功率

$$P_{max}=\frac{U_{oc}^2}{4R_0}=\frac{(2\sqrt{5})^2}{4\times 20}=0.25W$$

三 解 ∵ $P=3I_{A'B'}\cdot U_{A'B'}\cdot\cos\varphi \Rightarrow$ 相电流 $I_{A'B'}=\frac{5.7\times10^3}{3\times380\times0.5}=10A$，因 $\cos\varphi=\frac{1}{2}$

∴ $\dot{I}_{A'B'}=10\angle -60°$

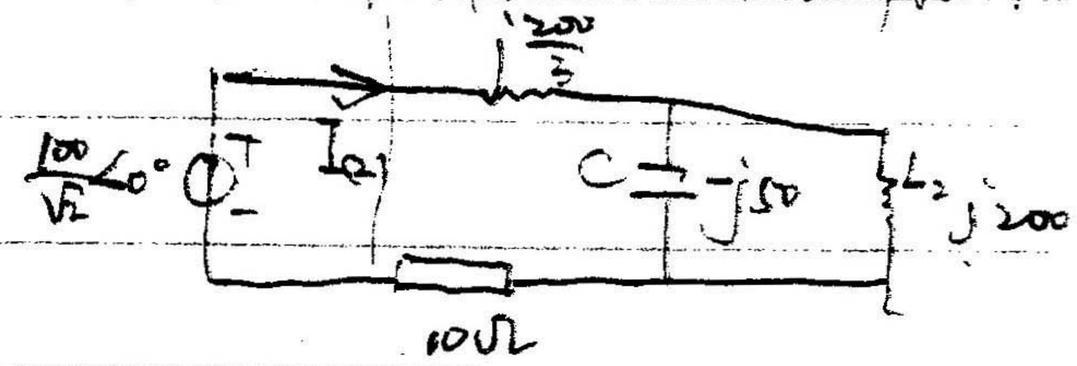
∴ $\dot{I}_A=10\sqrt{3}\angle -90°A$，$\dot{I}_B=10\sqrt{3}\angle -210°A$，$\dot{I}_C=10\sqrt{3}\angle 30°A$

$\dot{U}_{AB}=\dot{I}_A Z_l+\dot{U}_{A'B'}-\dot{I}_B Z_l=396.3\angle -47°V$

四 解 1）直流 $U_{sc1}=100V$ 作用下，$I_{c1}=\frac{100}{10}A=10A$

2）直流源单独作用下，L_2 与 C 并联谐振，$\dot{I}_{c2}=0$

3）二次谐波作用下，电路如下图所示

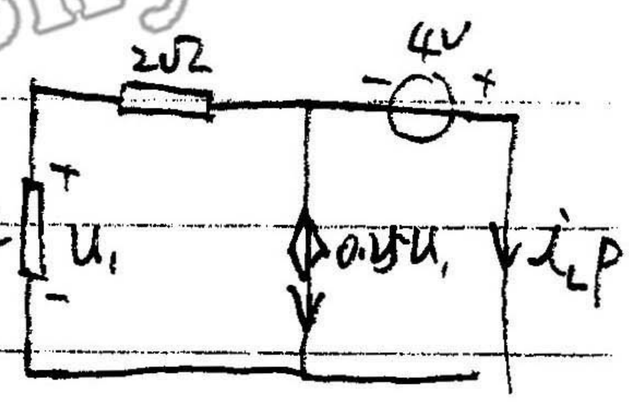


$Z=10+j\frac{200}{3}+(j200//(-j50))=10\Omega$

$\therefore \dot{I}_{c2}=\frac{\frac{100}{\sqrt{2}}\angle 0°}{10}A=\frac{10}{\sqrt{2}}\angle 0°$

$\Rightarrow i=10+10\cos 200t\ A$　　$P=\left[10^2+\left(\frac{10}{\sqrt{2}}\right)^2\right]\times 10W=1500W$

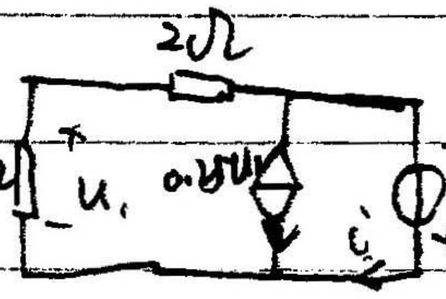
五．$0\le t<2s$ 时，$U_s=4V$，电路如下图所示



$U_1=4(0.25U_1+i_{LP})\quad 2U_1=-2(0.25U_1+i_{LP})$

$\Rightarrow i_{LP}=1.5A$

用外加电源法求 R_{eq}



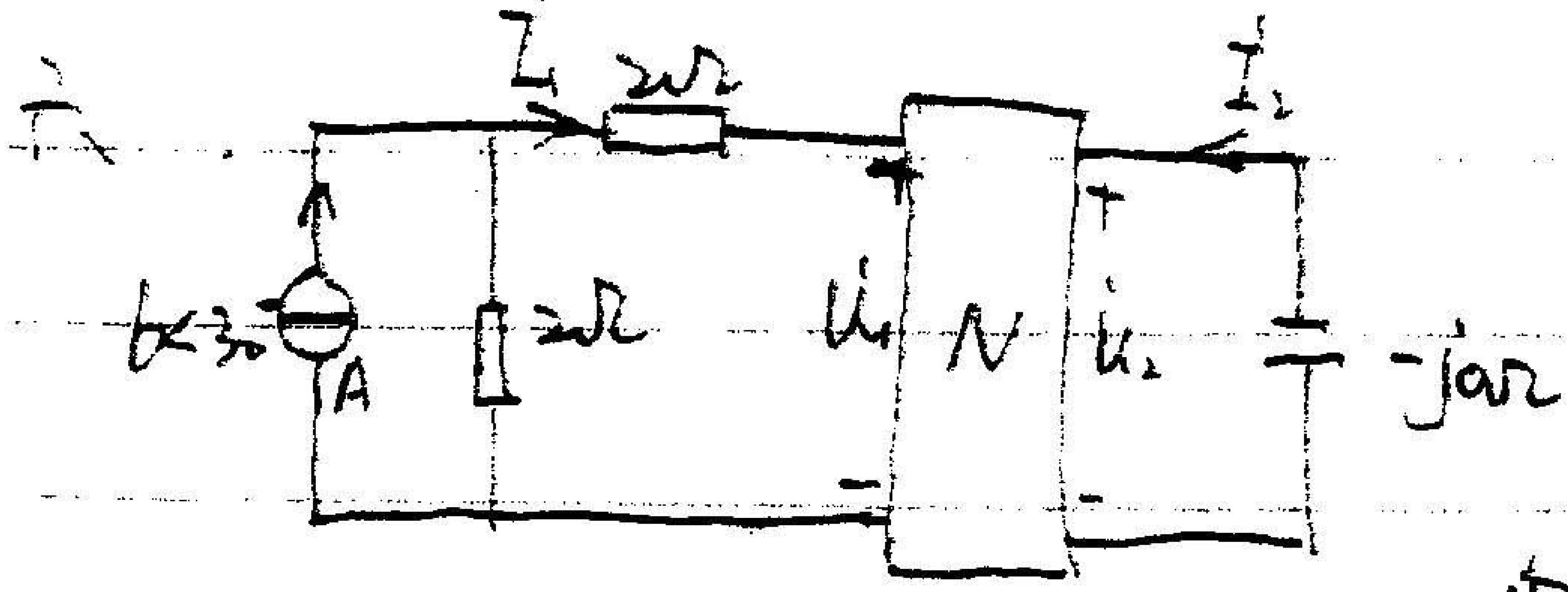
$\Rightarrow \begin{cases} U=4(i+0.25U_1) \\ U_1=-2(0.25U_1+i) \end{cases} \Rightarrow \frac{U}{i}=R_{eq}=\frac{8}{3}\Omega$

$\tau=\frac{L}{R_0}=3s$　于是 $i_L(t)=1.5-1.5e^{-\frac{3}{8}t}\ (A)\quad (0\le t<2)$

当 $t\ge 2s$ 时，$U_s=0$，$i_L(2-)=i_L(2+)=0.73A$，$i_L(\infty)=0$，$\tau=3s$，$i_L(t)=0.73e^{-\frac{3}{8}t}\ A$

于是 $i_L(t)=\begin{cases} 1.5-1.5e^{-\frac{3}{8}t}\ A & (0\le t<2) \\ 0.73e^{-\frac{3}{8}(t-2)}\ A & (t\ge 2) \end{cases}$

六、



据Z参数可知

$\dot U_1=(2+j2)\dot I_1+j2\dot I_2$ ①

$\dot U_2=j2\dot I_1+j12\dot I_2$ ②

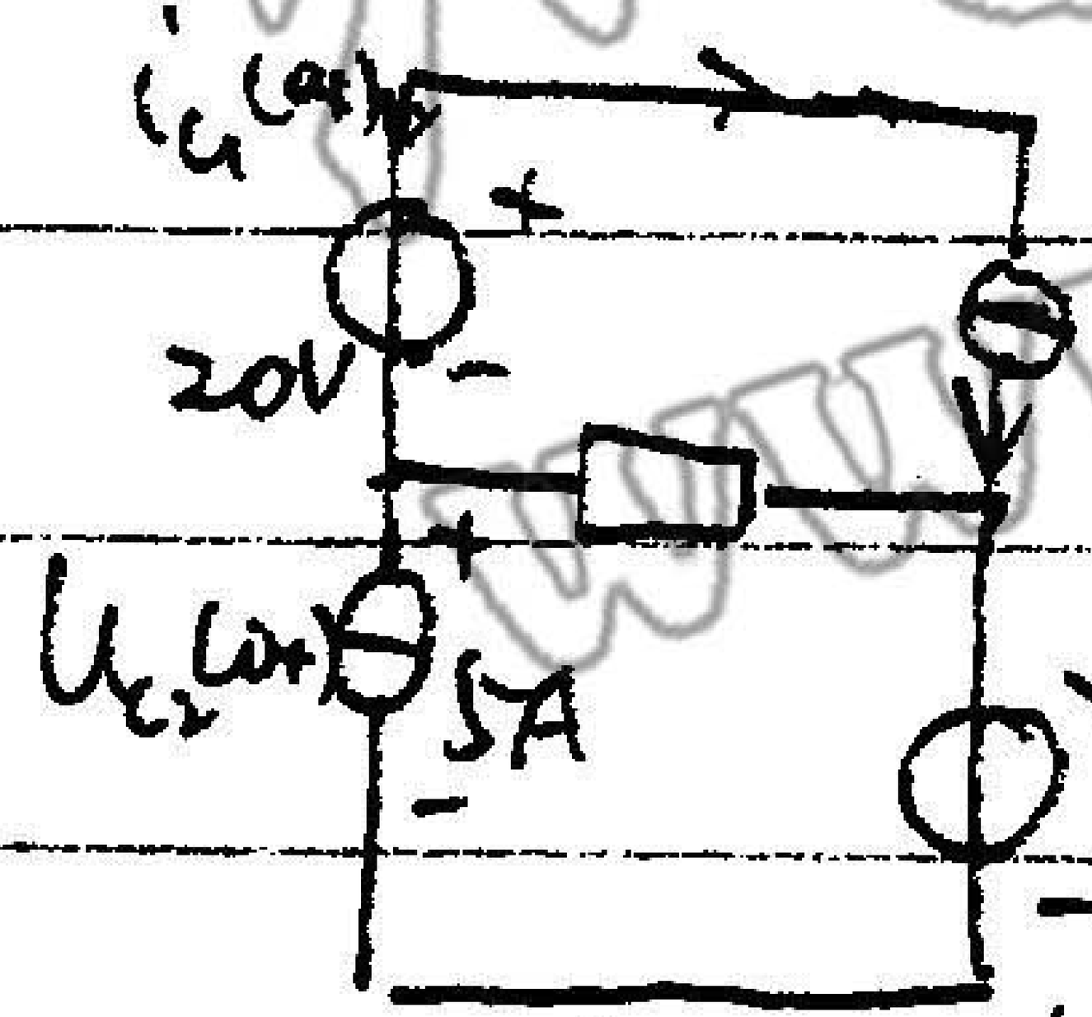
由题图可知 $\dot U_1=-2\dot I_1+2(6\angle 30^\circ-\dot I_1)$ ③

$\dot U_2=j10\dot I_2$ ④

$\Rightarrow \dot I_1=2\angle 30^\circ A$ $\dot U_2=20\angle -60^\circ V$

七、1. 电路处于稳态，$i_{L_1}(0_-)=i_{L_2}(0_-)=\frac{25}{5}A=5A$，$u_{C_1}(0_-)=u_{C_2}(0_-)=20V$

$t=0_+$ 时刻的等效电路如图所示



由换路定律 $i_L(0_+)=i_L(0_-)=5A$

$u_{C_2}(0_+)=u_{C_2}(0_-)=20V$，据KCL知 $i_{L_1}(0_+)=-5A$

由KVL知 $u_{C_2}(0_+)=-4\times 10+20=-20V$

故换路后 $i_L(0_+)=5A$，$u_{C_2}(0_+)=20V$，$i_{C_1}(0_+)=-5A$ $u_{L_1}(0_+)=-20V$

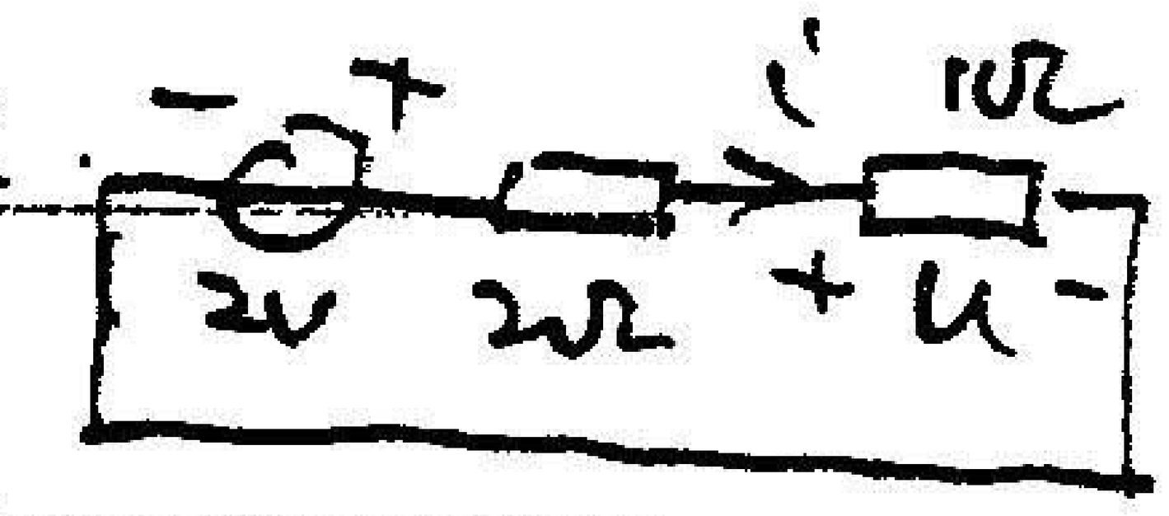
2. 设流过R_2电流为i_{R_2}，选i_{L_1}、i_{L_2}及u_C为状态变量

$$\begin{cases} i_{L_1}=C\cdot\frac{du_C}{dt}+i_{L_2} \\ i_{R_2}=-i_S-C\cdot\frac{du_C}{dt}=-i_S-(i_{L_1}-i_{L_2}) \end{cases}$$

$L_1\cdot\frac{di_{L_1}}{dt}=u_S-R_1 i_{L_1}+R_2 i_{R_2}-u_C$

$L_2\cdot\frac{di_{L_2}}{dt}=u_C-R_2 i_{R_2}$

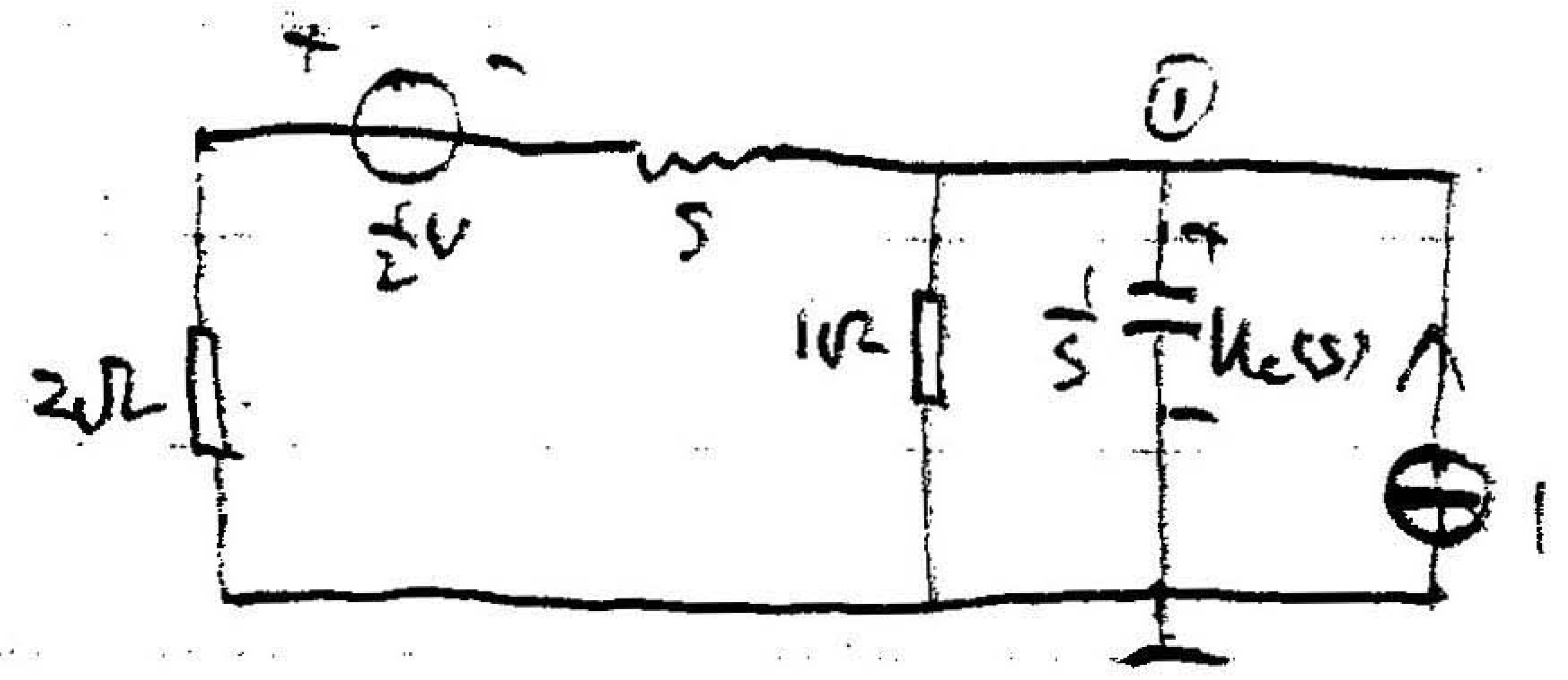
3. 在①段时，$u=2V$（当$u<0$才有）；在②段时，电路如图所示



$i=\frac{2}{3}A$ $u=\frac{2}{3}V$

八、解 S闭合前电路如图所示

D3



结点电压法 $(1+s+\frac{1}{2+s})U_1 = 1+\frac{-\frac{1}{2}}{2+s}$ 且 $U_1 = U_c(s) \Rightarrow U_c(s) = \frac{s+\frac{3}{2}}{s^2+3s+3}$

$\Rightarrow u_c(t) = \mathcal{L}^{-1}[U_c(s)] = e^{-\frac{3}{2}t}\cos\frac{\sqrt{3}}{2}t \ (t\geq 0) \Rightarrow i_c(t) = C\cdot\frac{du_c}{dt} = -\frac{3}{2}e^{-\frac{3}{2}t}\cos\frac{\sqrt{3}}{2}t$

$-\frac{\sqrt{3}}{2}e^{-\frac{3}{2}t}\sin\frac{\sqrt{3}}{2}t \ (t\geq 0)$

九、解：$\omega_1 = 1000\,rad/s$ 时，功率表读数最大，电路发生谐振

$\omega_1 L = \frac{1}{\omega_1 C}$ ①　$P = \frac{5^2}{R} = 5W \Rightarrow R = 5\Omega$

$\omega_2 = 1500\,rad/s$ 时，$I = \frac{U_s}{\sqrt{25+(\omega_2 L - \frac{1}{\omega_2 C})^2}}$

于是 $25 = \frac{25}{25+(\omega_2 L - \frac{1}{\omega_2 C})^2} \times 5$　②

由①②得　$L = 6mH$　　$C = 167\mu F$.