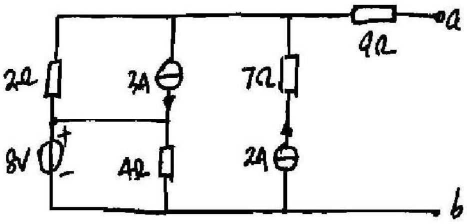
西南交通大学电路分析历年考研真题参考答案

2005

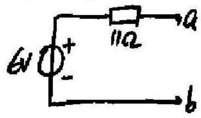
一.1. 解：



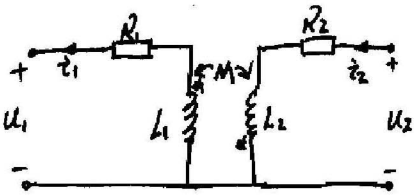
等效电阻 $R_{ab}=11\Omega$

利用叠加法求开路电压 $U_{ab}=6V$

∴



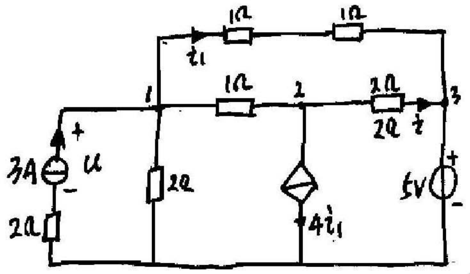
2. 解：



$$\begin{cases} u_1 = -R_1 i_1 - L_1\frac{di_1}{dt} - M\frac{di_2}{dt} \\ u_2 = R_2 i_2 + L_2\frac{di_2}{dt} + M\frac{di_1}{dt} \end{cases}$$

（自感电压看关联，互感电压看同名）

二. 解：

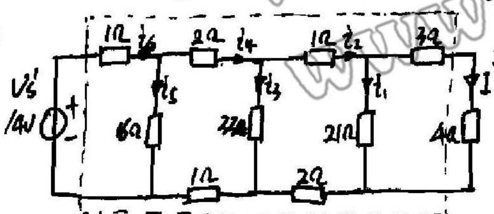


结点电压法：

$$\begin{cases} (\frac{1}{2}+1+\frac{1}{2})U_1 - U_2 - \frac{1}{2}U_3 = 3 \\ -U_1 + (1+\frac{1}{2})U_2 - \frac{1}{2}U_3 = -4i_1 \\ U_3 = 5V \\ i_1 = \frac{U_1-U_3}{2} \end{cases} \Rightarrow \begin{cases} U_1 = \frac{83}{16}V \\ U_2 = \frac{39}{8}V \\ U_3 = 5V \end{cases}$$

$i = \frac{U_2-U_3}{2} = -\frac{1}{16}A \quad u = U_1+6 = \frac{179}{16}V$

三. 解：



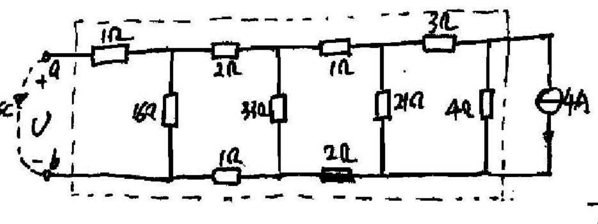
(a)

① 令 $I'=3A$ 则 $i_1=1A \quad i_2=4A$

$i_3 = \frac{4+21+8}{33} = 1A \quad i_4 = 5A$

$i_5 = 3A \quad i_6 = 8A \quad \therefore U_s' = 8+16\times3 = 56V$

$\therefore \frac{U_s}{U_s'} = \frac{I}{I'} \Rightarrow \frac{14}{56} = \frac{I}{3} \Rightarrow I = 0.75A$



② 应用互易定理 3.

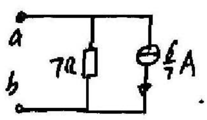
令 $I'=3A$

$\frac{12}{U_s'} = \frac{i_{sc}}{-4} \Rightarrow \frac{12}{56} = \frac{i_{sc}}{-4} \Rightarrow i_{sc} = -\frac{6}{7}A$

求 a b 两点间诺顿等效电路

$R_{ab} = \frac{U_s'}{i_6} = \frac{56}{8} = 7\Omega$

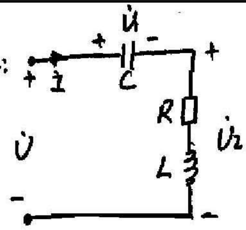
∴



$\therefore U_{ab} = -6V$

西南交通大学电路分析历年考研真题参考答案

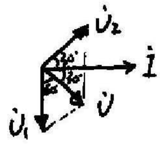
四. 解：



令 $\dot{I} = 10\angle 0^\circ$ A

则 $\dot{U} = 200\angle -30^\circ$ V

$\dot{U}_1 = 200\angle -90^\circ$ V　$\dot{U}_2 = 200\angle 30^\circ$ V

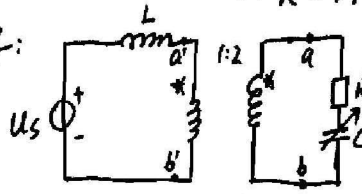


$$\frac{U_1}{I} = \frac{1}{\omega C} = 20 \Rightarrow C = \frac{1}{20\times 2\pi\times 50} = 159\,uF$$

$$\frac{\dot{U}_2}{\dot{I}} = \frac{200\angle 30^\circ}{10\angle 0^\circ} = 20\angle 30^\circ = 10\sqrt{3} + 10j = R + j\omega L$$

$\therefore R = 17.32\Omega$　$2\pi f L = 10$ $\Rightarrow L = 31.8\,mH$

五. 解：



求 a.b 两点等效电路

开路电压 $\dot{U}_{OC} = 2\dot{U}_{a'b'} = 200\angle 0^\circ$ V

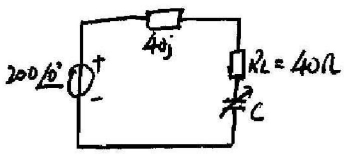
短路电流 $\dot{I}_{SC}$：

$$\dot{I}_1 = \frac{\dot{U}_S}{\omega L\angle 90^\circ} = \frac{100\angle 0^\circ}{10\angle 90^\circ} = 10\angle -90^\circ \text{ A}$$

$$\dot{I}_{SC} = \frac{1}{2}\dot{I} = 5\angle -90^\circ \text{ A}$$

$$\therefore Z_{eq} = \frac{200\angle 0^\circ}{5\angle -90^\circ} = 40\angle 90^\circ = 40j$$

a. b 等效电路如下：



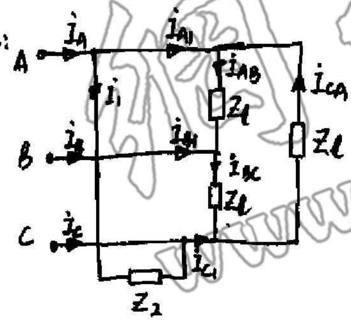
$\therefore$ 当 $\frac{1}{\omega C} = 40$ 时

R_L 可获最大功率

$$C = \frac{1}{200\times 40} = 125\,uF$$

$$P_{max} = \frac{U_{oc}^2}{40} = 1000\,W$$

六. 解：



$$\dot{I}_{AB} = \frac{\dot{U}_{AB}}{Z_1} = \frac{380\angle 0^\circ}{300\sqrt{2}\angle -45^\circ} = 0.9\angle 45^\circ \text{ A}$$

$$\dot{I}_{BC} = 0.9\angle 45^\circ - 120^\circ = 0.9\angle -75^\circ \text{ A}$$

$$\dot{I}_{CA} = 0.9\angle 45^\circ + 120^\circ = 0.9\angle 165^\circ \text{ A}$$

$\dot{U}_{BC} = 380\angle -120^\circ$ V　$\dot{U}_{CA} = 380\angle 120^\circ$ V

$\dot{U}_{AC} = 380\angle -60^\circ$ V

$$\therefore \dot{I}_1 = \frac{\dot{U}_{AC}}{Z_2} = \frac{380\angle -60^\circ}{100\angle 90^\circ} = 3.8\angle -150^\circ \text{ A}$$

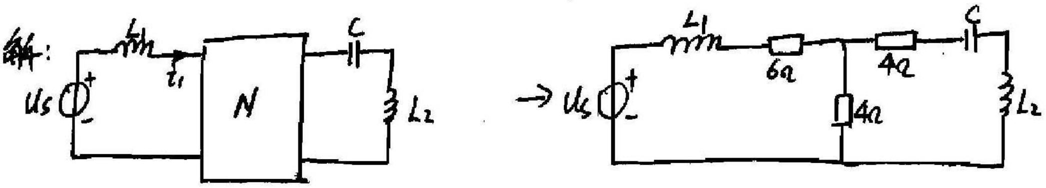
$$\therefore \dot{I}_A = \dot{I}_1 + \dot{I}_{AB} - \dot{I}_{CA} = -1.79 + 2.3j = 2.92\angle 127.9^\circ \text{ A}$$

$$\dot{I}_B = \dot{I}_{B1} = 1.56\angle -105^\circ \text{ A}$$

$$\dot{I}_C = \dot{I}_{C1} - \dot{I}_1 = 0.69 - 1.2j \text{ A}$$

西南交通大学电路分析历年考研真题参考答案

七. 解:



$$T=\begin{bmatrix}2.5 & 16\Omega\\ 0.25S & 2\end{bmatrix} \Rightarrow Z=\begin{bmatrix}10 & 4\\ 4 & 8\end{bmatrix}$$

当直流作用时 $U_S=10V$ $\quad i_{1(0)}=\frac{10}{10}=1A$

$$\dot I_{1(1)}=\frac{20\angle -20^\circ}{8+j4}=2.25\angle -46.56\ A$$

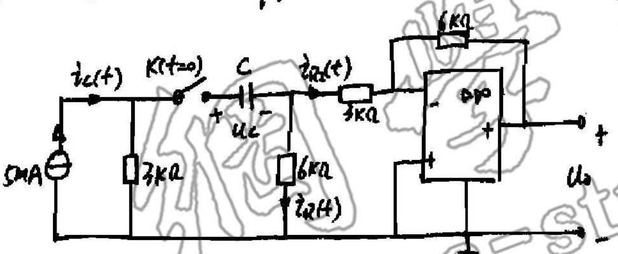
$\therefore i_{1(1)}=3.177\cos(10^3t-46.56)A$

$\therefore i_1=10+3.177\cos(10^3t-46.56)A$

$I_{rms}=\sqrt{I_0^2+I_1^2}=\sqrt{100+3.177^2}=10.5A$

$P=U_0I_0+U_1I_1\cos\varphi_1=10\times1+20\times2.25\times\cos26.56^\circ=50.25W$

八.

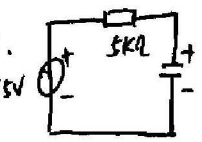


解: $u_C(0_-)=u_C(0_+)=-5V$

求电容两端等效电路: ①开路电压: $U_{OC}=15V$

②短路电流: $i_{SC}=\frac{15}{5K}=3mA$

∴



$\therefore R_{eq}=\frac{U_{OC}}{3mA}=5K\Omega$

$\tau=RC=5K\times100uF=0.5S$

$u_C(+\infty)=15V$

$\therefore u_C(t)=15+(-5-15)e^{-2t}\ (t\geq0)=15-20e^{-2t}\ (t\geq0)$

$i_C(t)=C\frac{du_C(t)}{dt}=4e^{-2t}\ mA\ (t\geq0)$

$3\times4e^{-2t}+15-20e^{-2t}+u_R(t)=15$

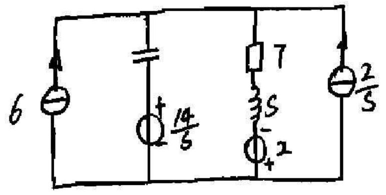
$\therefore u_R(t)=8e^{-2t}V\ (t\geq0)\quad i_R(t)=\frac{4}{3}e^{-2t}\ mA\ (t\geq0)$

$i_{R2}(t)=i_C(t)-\frac{4}{3}e^{-2t}=\frac{8}{3}e^{-2t}\ mA\ (t\geq0)$

$\therefore \frac{u_0(t)-0}{6}=-\frac{8}{3}e^{-2t}$

$u_0(t)=-16e^{-2t}\ (t\geq0)$

九、解：$u_C(0-)=14V$　$i_L(0-)=2A$



$$\left(\frac{s}{10}+\frac{1}{7+s}\right)U_C(s)=6+1.4-\frac{2}{7+s}+\frac{2}{s}$$

$$U_C(s)=\frac{74s^2+518s+40}{s(s+2)(s+5)}=\frac{14}{s}+\frac{100}{s+2}+\frac{-40}{s+5}$$

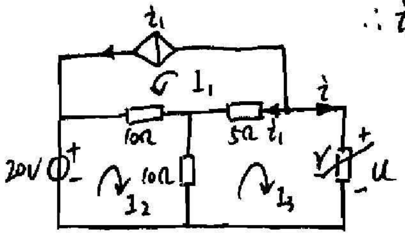
$$\therefore u_C(t)=14+100e^{-2t}-40e^{-5t}\ V\quad(t\geq 0)$$

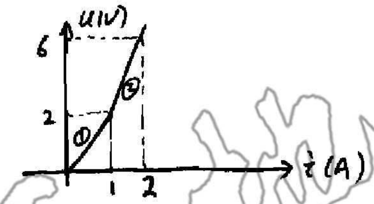
$$I_L(s)=\frac{U_C(s)+2}{7+s}=\frac{2s^3+88s^2+538s+140}{s(s+2)(s+5)(s+7)}$$

$$=\frac{2}{s}+\frac{20}{s+2}+\frac{-20}{s+5}$$

$$\therefore i_L(t)=2+20e^{-2t}-20e^{-5t}\ A\quad(t\geq 0)$$

十、解：





将V-I特性曲线分为两个工作区.

①区：$u\leq 2V$，$i\leq 1A$　②区：$u\geq 2V$，$i\geq 1A$

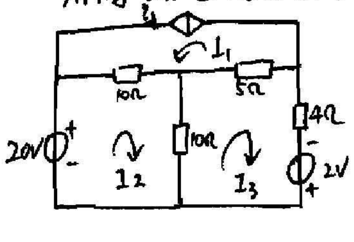
(1) 假设工作在1区，则 $r=\frac{2}{1}=2\Omega$

$$\begin{cases}10(I_1+I_2)+10(I_2-I_3)=20\\10(I_3-I_2)+5(I_1+I_3)+2I_3=0\\i_1=-(I_1+I_3)=I_1\Rightarrow I_3=-2I_1\end{cases}\Rightarrow\begin{cases}I_1=-\frac{5}{7}A\\I_3=\frac{10}{7}A\end{cases}$$

$\because I_3>1A$，$\therefore$ 工作点不在1区（舍去）

(2) 假设工作于②区，$u=4i-2$

$\therefore$ 原等效电路如下：



$$\begin{cases}10(I_1+I_2)+10(I_2-I_3)=20\\10(I_3-I_2)+5(I_1+I_3)+4I_3=2\\i_1=-(I_1+I_3)=I_1\Rightarrow I_3=-2I_1\end{cases}$$

$$\Rightarrow\begin{cases}I_1=-\frac{2}{3}A\\I_3=\frac{4}{3}A>1A\end{cases}$$

$$\therefore u=4I_3-2=\frac{16}{3}-\frac{6}{3}=\frac{10}{3}V\quad i=I_3=\frac{4}{3}A$$