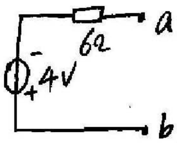
2007

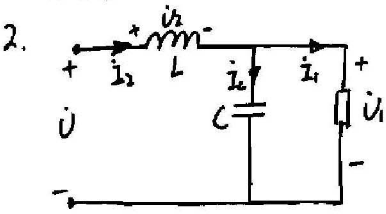
一、1. 解：利用电源叠加法.

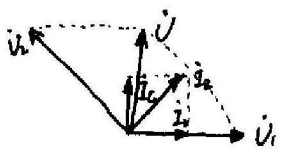
等效电阻：$R_{ab} = 6\Omega$

开路电压：$U_{ab} = -4V$



2.





解：$\dot{U}_1 = U_1\angle 0°\ V$

$\dot{I}_C = \frac{\dot{U}_1}{\frac{1}{\omega C}\angle -90°} = \frac{U_1\angle 0°}{R\angle -90°} = \frac{U_1}{R}\angle 90°\ A$

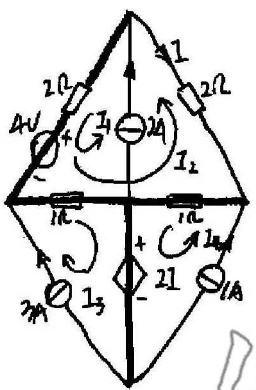
$\dot{I}_1 = \frac{\dot{U}_1}{R} = \frac{U_1}{R}\angle 0°\ A$

$\dot{I}_2 = \dot{I}_1 + \dot{I}_c = \sqrt{2}\frac{U_1}{R}\angle 45°\ A$

$\dot{U}_2 = \dot{I}_2 R\angle 90° = \sqrt{2}U_1\angle 135°\ V$

$\dot{U} = \dot{U}_1 + \dot{U}_2 = 2U_1 + U_1 j\ V$

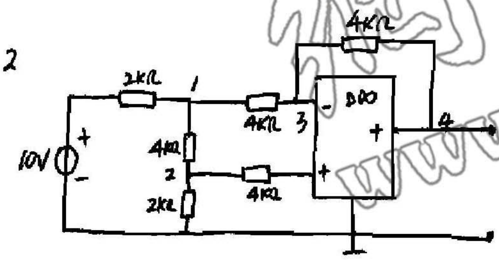
二. 1.



解：
$$\begin{cases} I_1 = 2A \\ 2(I_1+I_2) + 4 + (I_1+I_2+I_3) + (I_2 - I_4) + 2I_2 = 0 \\ I_3 = 3A \\ I_4 = 1A \end{cases}$$

$\Rightarrow I = -I_2 = 2A$

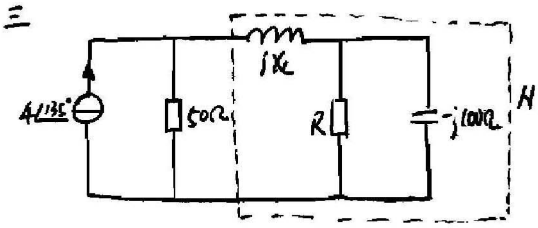
2



解：
$$\begin{cases} (\frac{1}{2k} + \frac{1}{6k} + \frac{1}{4k})U_1 - \frac{1}{4k}U_3 = \frac{10}{2k} \\ -\frac{1}{4k}U_1 + (\frac{1}{4k} + \frac{1}{4k})U_3 = \frac{U_4}{4k} \\ \frac{U_1}{6k}\times 2K = U_3 \Rightarrow U_1 = 3U_3 \end{cases}$$

$$\Rightarrow \begin{cases} U_1 = 6V \\ U_2 = 2V \\ U_3 = 2V \\ U_4 = -2V \end{cases}$$

三



解：若网络N获最大功率

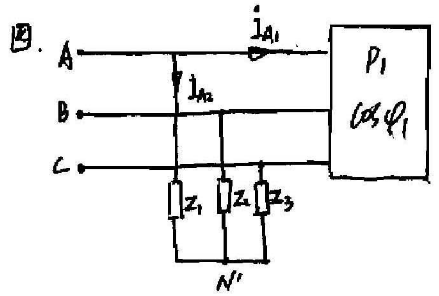
则 $R_N = 50\Omega$

$P_{max} = \frac{U_{oc}^2}{4R_N} = \frac{(4\times 50)^2}{4\times 50} = 200W$

$jX_L + \frac{R\cdot(-j100)}{R - j100} = jX_L + \frac{-R\cdot j100(R+j100)}{R^2 + 100^2}$ $\Rightarrow R = 100\Omega$

$X_L = 50\ rad/s\cdot H$

四.



解：$\dot{U}_{AB} = 380\angle 30^\circ$ V

$P = 3U_A I_{A1}\cos\varphi_1$

$\dot{U}_A = 220\angle 0^\circ$ V　$\dot{U}_B = 220\angle -120^\circ$ V

$\therefore I_{A1} = \dfrac{P}{3U_A\cos\varphi_1} = \dfrac{5000}{3\times 220\times 0.85} = 8.91$ A

$\cos\varphi_1 = 0.85$　$\varphi_1 = 31.79^\circ$

$\therefore \dot{I}_{A1} = \dfrac{\dot{U}_A}{Z} = 8.91\angle -31.79^\circ$ A

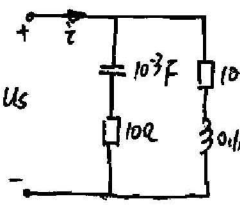
$\dot{I}_{A2} = \dfrac{\dot{U}_A}{Z} = \dfrac{220\angle 0^\circ}{22\angle -30^\circ} = 10\angle 30^\circ$ A

$\therefore \dot{I}_A = \dot{I}_{A1} + \dot{I}_{A2} = 16.23\angle -1^\circ$ A

$\dot{I}_B = 16.23\angle -121^\circ$ A

$\dot{I}_C = 16.23\angle 119^\circ$ A

五.



解：$u_S = 100 + 100\sin 100t$ (V)

当直流作用时

$i_1 = \dfrac{100}{10} = 10$ A

当交流作用时：$X_C = \dfrac{1}{wC} = 10\Omega$　$X_L = wL = 10\Omega$

$\therefore Z = \dfrac{(10-j10)(10+j10)}{10-j10+10+j10} = 10\Omega$

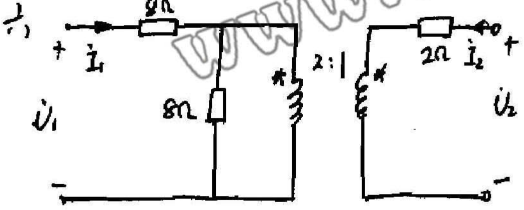
$\dot{U}_S = \dfrac{100}{\sqrt{2}}\angle -90^\circ$ V　$\therefore \dot{I}_{(1)} = \dfrac{10}{\sqrt{2}}\angle -90^\circ$ A

$\therefore i_{(1)}(t) = 10\sin 100t$ A

$\therefore i(t) = 10 + 10\sin 100t$ A

$P = U_0 I_0 + U_1 I_1\cos\varphi_1 = 100\times 10 + \dfrac{100}{\sqrt{2}}\cdot\dfrac{10}{\sqrt{2}} = 1500$ W

六.



解：$\begin{cases} \dot{U}_1 = A\dot{U}_2 - B\dot{I}_2 \\ \dot{I}_1 = C\dot{U}_2 - D\dot{I}_2 \end{cases}$

$A = \dfrac{\dot{U}_1}{\dot{U}_2}\Big|_{\dot{I}_2=0} = 4$

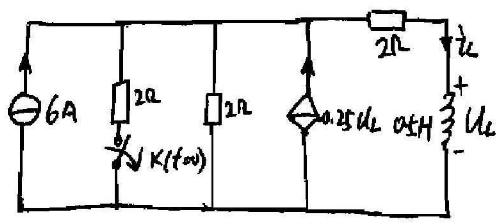
$D = -\dfrac{\dot{I}_1}{\dot{I}_2}\Big|_{\dot{U}_2=0} = 1$

$B = -\dfrac{\dot{U}_1}{\dot{I}_2}\Big|_{\dot{U}_2=0} = 12\Omega$

$C = \dfrac{\dot{I}_1}{\dot{U}_2}\Big|_{\dot{I}_2=0} = \dfrac{1}{4}$ S

$\therefore T = \begin{bmatrix} 4 & 12\Omega \\ \frac{1}{4}S & 1 \end{bmatrix}$

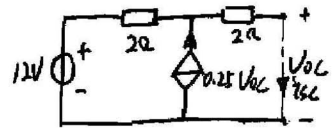
七.



解：$i_L(0+) = i_L(0-) = 2A$

$t \geq 0$时，求 U_L 两端等效电路

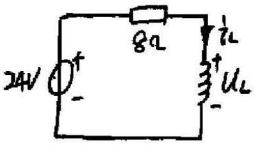
① 开路电压 U_{OC}



$2\times 0.25U_{OC} + 12 = U_{OC}$

$\Rightarrow U_{OC} = 24V$

② 短路电流 $i_{SC} = \frac{12}{4} = 3A$　　∴ $R_{eq} = \frac{U_{OC}}{i_{SC}} = \frac{24}{3} = 8\Omega$.



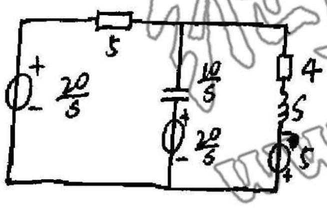
∴ $i_L(+\infty) = 3A$

$\tau = \frac{L}{R} = \frac{0.5}{8} = \frac{1}{16}s$

∴ $i_L(t) = 3 + (2-3)e^{-16t} = 3 - e^{-16t}$ A $(t \geq 0)$

$u_L(t) = L\frac{di_L(t)}{dt} = 0.5\times 16e^{-16t} = 8e^{-16t}$ V $(t \geq 0)$

八、解：$U_C(0-) = 20V$　$i_L(0-) = 5A$



$(\frac{1}{5} + \frac{s}{10} + \frac{1}{4+s})U_C(s) = \frac{4}{s} + 2 - \frac{5}{4+s}$

$U_C(s) = \frac{20s^2+70s+160}{s^3+6s^2+18s}$

$= \frac{K_1}{s} + \frac{K_{21}}{s-(-3+3j)} + \frac{K_{22}}{s-(-3-3j)}$

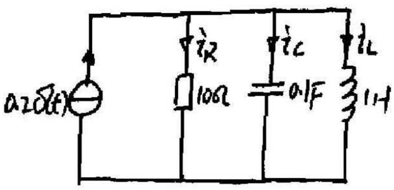
$K_1 = \frac{20s^2+70s+160}{3s^2+12s+18}\Big|_{s=0} = \frac{80}{9}$

$K_{21} = \frac{20s^2+70s+160}{3s^2+12s+18}\Big|_{s=-3+3j} = 6.21\angle 26.56$.　　$K_{22} = 6.21\angle -26.56$

∴ $U_C(t) = \frac{80}{9} + 12.42e^{-3t}\cos(3t+26.56)$ V $(t \geq 0)$

九、解：$i_L(0-) = 1A$　$U_C(0-) = 0V$

换路后：



$i_C(t) = C\frac{du_C(t)}{dt} = 0.1\frac{du_C(t)}{dt}$

$u_L(t) = L\frac{di_L(t)}{dt}$　　$i_C(t) = LC\frac{d^2i_L(t)}{dt^2}$　　$i_R(t) = \frac{L}{R}\frac{di_L(t)}{dt}$

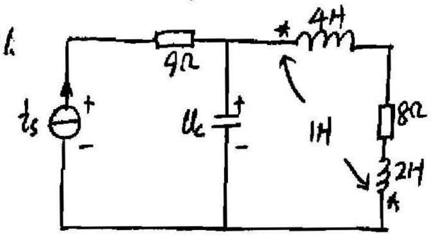
$0.1\frac{d^2i_L(t)}{dt^2} + 0.1\frac{di_L(t)}{dt} + i_L(t) = 0.2\delta(t)$

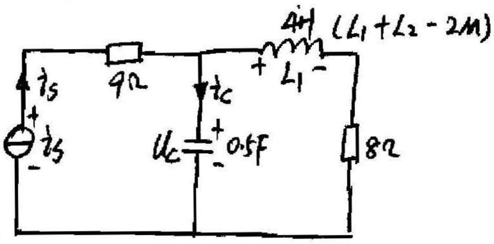
$\int_{0-}^{0+}\frac{d^2i_L(t)}{dt^2} + \int_{0-}^{0+}\frac{di_L(t)}{dt}\cdot dt + 10(i_{L0+} - i_{L0-}) = 2.$

$\frac{di_L(t)}{dt}\Big|_{0+} - \frac{di_L(t)}{dt}\Big|_{0-} + i_L(0+) - i_L(0-) = 2$

$i_L(0+) = 1A$　$\frac{di_L(t)}{dt}\Big|_{0-} = 0$　$i_L(0-) = 0$　∴ $\frac{di_L(t)}{dt}\Big|_{0+} = 2A/s$

十．1.





解：取 u_c, i_L 为自变量

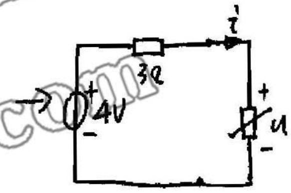
$i_c + i_L = i_s \Rightarrow i_c = -i_L + i_s \Rightarrow \frac{du_c(t)}{dt} = -2i_L + 2i_s$ ①

$u_L + 8i_L = u_c \Rightarrow u_L = u_c - 8i_L \Rightarrow \frac{di_L(t)}{dt} = 0.25u_c - 2i_L$ ②

$$\therefore \begin{pmatrix} \frac{du_c(t)}{dt} \\ \frac{di_L(t)}{dt} \end{pmatrix} = \begin{pmatrix} 0 & -2 \\ 0.25 & -2 \end{pmatrix} \begin{pmatrix} u_c \\ i_L \end{pmatrix} + \begin{pmatrix} 2 \\ 0 \end{pmatrix} i_s$$

2.

$$u = \begin{cases} 0 & i < 0 \\ i^2 & i \geq 0 \end{cases}$$



解：当 $i<0$ 时 $u=0$

$i = \frac{4}{3}A > 0$（不符题意，舍去）

当 $i \geq 0$ 时

$3i + i^2 = 4 \Rightarrow i = 1A$ 或 $i = -4A$（舍）

$\therefore i = 1A \quad u = i^2 = 1V$