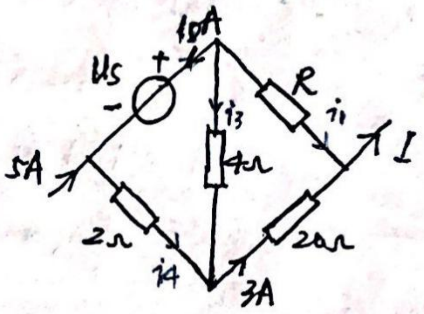
并非标准

仅供参考

二〇一八～二〇一九 "电路III" B卷

一、一般计算题

1. 试求 I、电压 U_S 和电阻 R.



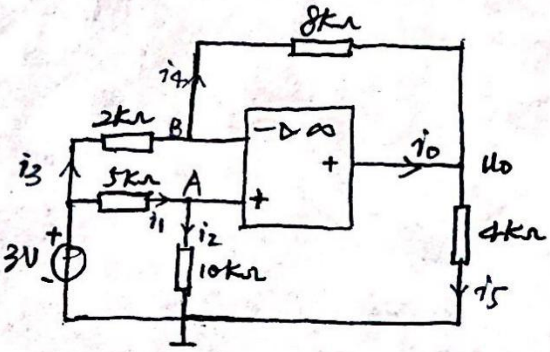
$$\begin{cases} 10+i_1+i_3=0 \\ i_4=5+10 \\ i_3+i_4=3 \end{cases} \quad \begin{cases} i_1=2A \\ i_3=-12A \\ i_4=15A \end{cases}$$

$I=5A$（广义节点亦可得出）

$U_S=4i_3-2i_4 \Rightarrow U_S=-78V$

$U_R=4i_3+20\times3 \Rightarrow U_R=12V$，$R=\frac{U_R}{i_1}=6\Omega$

2. 求 u_o、i_o.



虚断：$i_{AB}=0A$，故 $i_1=i_2=\frac{3}{5+10}=0.2mA$.

$u_A=10\times i_2=2V$. 且 $i_3=i_4$.

虚短：$u_A=u_B=2V$.

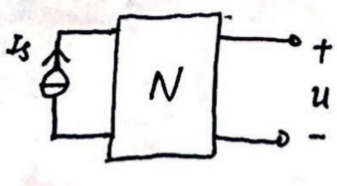
$i_3=i_4=\frac{3-2}{2}=0.5mA$.

$3=0.5\times2+0.5\times8+u_o \Rightarrow u_o=-2V$.

$i_5=\frac{-2}{4}=-0.5mA$.

$i_5=i_o+i_4 \rightarrow i_o=-1mA$

3. N 为含源线性网络，已知 $I_S=5A$ 时，$u=3V$；$I_S=0A$ 时，$u=-2V$.
求当 $I_S=-1A$ 时的电压 u 值.

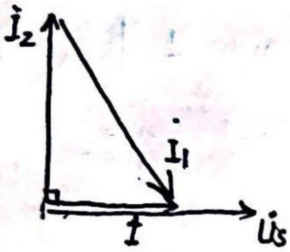


设 $u=k_1I_S+k_2$

$$\begin{cases} 3=5k_1+k_2 \\ -2=k_2 \end{cases} \Rightarrow \begin{cases} k_1=1 \\ k_2=-2 \end{cases} \quad 即\ u=I_S-2$$

$\because I_S=-1A$ 时 $u=-3V$.

4. $u_s=160\sqrt{2}\cos1000t$ V，有效值 $I=6A$，$I_1=10A$．求 u_s 与 i 同相时的电容值 C.

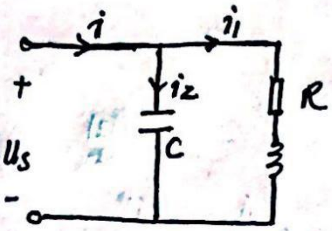


$\dot{I}=\dot{I}_1+\dot{I}_2$， $\dot{U}_s=160\angle0°V$.

$I=6A$，$I_1=10A$，$I_2=8A$

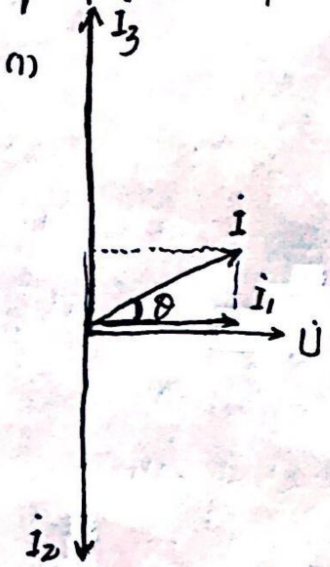
$X_C=\dfrac{U_s}{I_2}=20\Omega=\dfrac{1}{\omega C}$

$C=\dfrac{1}{\omega X_C}=50\mu F$.



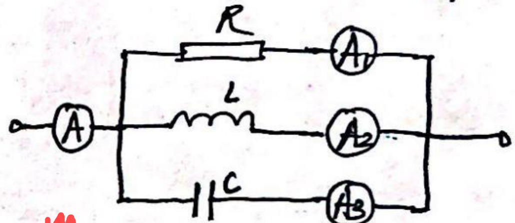
5. 正弦稳态电路，Ⓐ1 Ⓐ2 Ⓐ3 读数分别为4A，8A，11A．求 (1) 画出以端电压为参考向量的四个支路电流的相量图．(2) A的读数 (3) 端电压有效值为5V，求电路的平均功率P及无功功率Q．

(1)



(2)

$I=\sqrt{4^2+(11-8)^2}=5A$



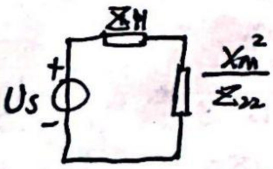
(3) $\theta=\cancel{36.9°}$ $-36.9°$（U滞后I 36.9°）

$P=UI\cos\theta=20W$

$Q=UI\sin\theta=15Var$. $-15Var$

6. $U_s=20V$，$Z_x=0.2-j9.8\Omega$．求负载 Z_x 获得最大功率时，互感抗 X_m.

（反映阻抗）

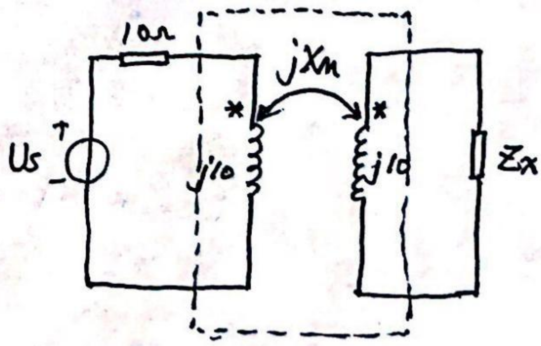


$Z_{22}=j10+Z_x=0.2+j0.2\Omega$

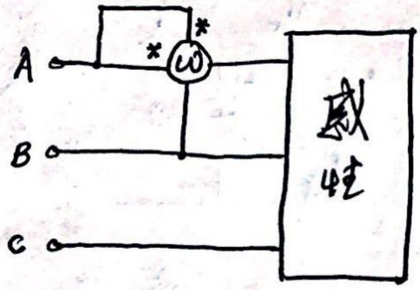
$Z_{11}=10+j10\Omega$

获最大功率时 $\dfrac{X_m^2}{Z_{22}}=10-j10\Omega$.

$X_m=2\Omega$.



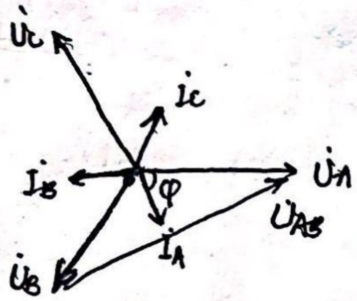
7. 对称三相电路中，线电压 $U_{AB}=380V$，功率表读数为 275.3W．负载功率因数为 0.6．
求 (1) 线电流 I_A　(2) 负载吸收的总功率．



(1) 感性 $\cos\varphi=0.6$ } $\Rightarrow \varphi=53.1°$

$\therefore$ $\dot{U}_{AB}$ 超前 $\dot{U}_A$ 30°．

$\dot{I}_A$ 比 $\dot{U}_A$ 滞后 53.1°．

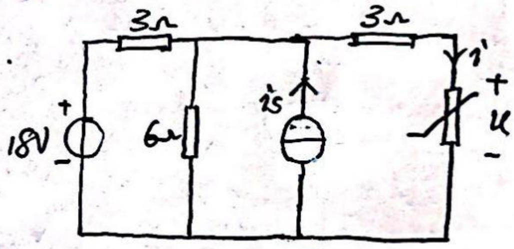


$P=U_{AB}I_A\cos(30°+53.1°)$

$\Rightarrow I_A=6.03A$

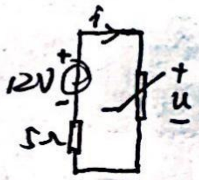
(2) $P_总=3P=825.9W$．

8. 已知 $i_s=15\cos 4t\,mA$，用小信号分析法求 $u(t)$．



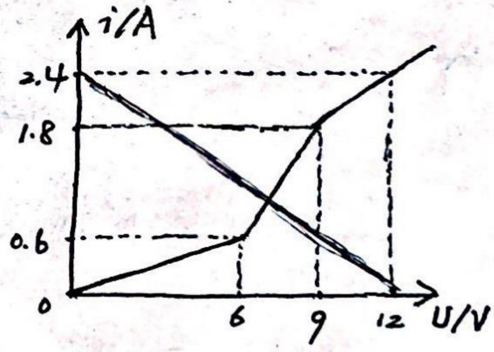
令 $i_s=0A$，$U_s=18V$：

$U_{oc}=12V$．$R_i=5\Omega$．(作出 UI 曲线)

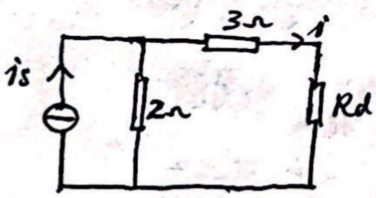


$\begin{cases}12=u+5i\\ i=0.4u-1.8\end{cases}$ 得 $\begin{cases}u=7V\\ i=1A\end{cases}$

$\therefore Q(7V,1A)$



令 $U_s=0V$，$i_s\neq 0A$：



$G_d=i'=0.4S$

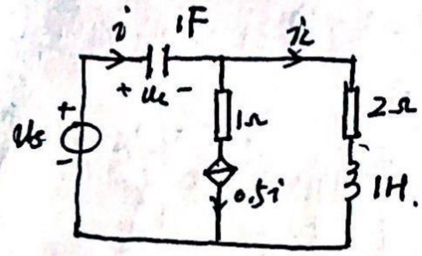
$R_d=2.5\Omega$．

$i=i_s\times\dfrac{2}{2+3+2.5}=4\cos 4t\,mA$．

$u=10\cos 4t\,mV=0.01\cos 4t\,V$．

故 $u(t)=7+0.01\cos 4t\ (V)$．

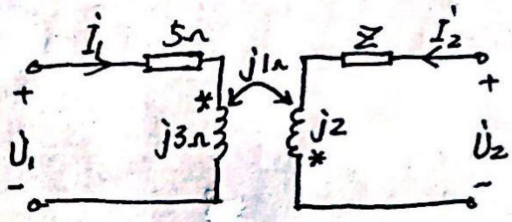
9. 列写其标准形式方程.



$$\begin{cases} i = C\dfrac{du_c}{dt} \\ i = 0.5i + i_L \\ u_s = u_c + 2i_L + L\dfrac{di_L}{dt} \end{cases} \Rightarrow \begin{cases} \dfrac{du_c}{dt} = 2i_L \\ \dfrac{di_L}{dt} = -u_c - 2i_L + u_s. \end{cases}$$

故 $\begin{bmatrix} \dfrac{du_c}{dt} \\ \dfrac{di_L}{dt} \end{bmatrix} = \begin{bmatrix} 0 & 2 \\ -1 & -2 \end{bmatrix}\begin{bmatrix} u_c \\ i_L \end{bmatrix} + \begin{bmatrix} 0 \\ 1 \end{bmatrix}[u_s]$.

10. $Z = 1-j\,\Omega$. 求二端口网络 Z 及 T 参数.



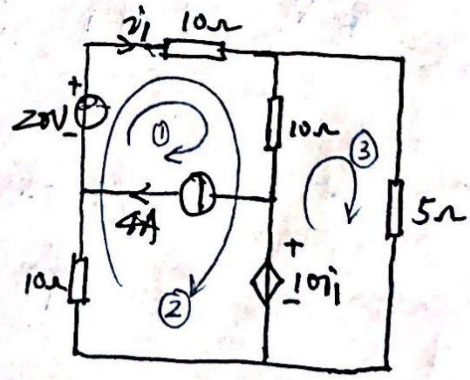
$$\begin{cases} \dot U_1 = 5\dot I_1 + j3\dot I_1 - j1\dot I_2 \\ \dot U_2 = (1-j)\dot I_2 - j2\dot I_2 - j1\dot I_1 \end{cases}$$

$$\Rightarrow \begin{cases} \dot U_1 = (5+j3)\dot I_1 - j1\dot I_2 \\ \dot U_2 = -j1\dot I_1 + (1-j3)\dot I_2 \end{cases} \quad Z = \begin{bmatrix} 5+j3 & -j \\ -j & 1-j3 \end{bmatrix}\Omega.$$

$$\Rightarrow \begin{cases} \dot U_1 = (-3+5j)\dot U_2 + (12+13j)\dot I_2 \\ \dot I_1 = j\dot U_2 + (3+j)\dot I_2 \end{cases} \quad T = \begin{bmatrix} -3+5j & -12-j13 \\ j & -3-j \end{bmatrix}.$$

二、综合计算题.

1. 求 i_1 及 CCVS 的输出功率.



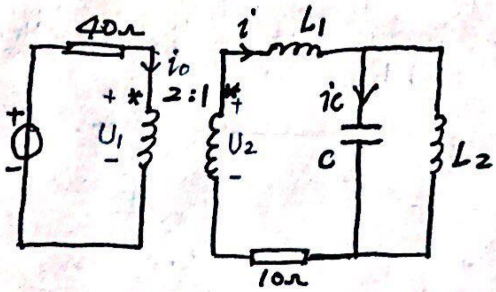
$$\begin{cases} ①\ I_1 = 4A. \\ ②\ 20 = 10(4+I_2) + 10(4+I_2-I_3) + 10i_1 + 10I_2 \\ ③\ 10i_1 = 10(I_3-I_2-4) + 5I_3 \\ i_1 = 4 + I_2 \end{cases}$$

$I_1 = 4A$, $I_2 = -1.75A$, $I_3 = 3A$, $i_1 = 2.25A$

$p = 10i_1 \times (I_2 - I_3) = -106.875W$

输出功率: $-106.875W$ (吸收 $106.875W$)

2. $u_s(t) = 40 + 240\sqrt{2}\cos\omega t + 40\sqrt{2}\cos 3\omega t$ V，$\omega L_1 = 3\Omega$，$\omega L_2 = 24\Omega$，$\frac{1}{\omega C} = 24\Omega$.
求(1) $i(t)$、$i_C(t)$ 及其有效值. (2) U_s发出的有功功率.



(1) a. $U_{s0}=40V$时 $i_0=0A$，$i_{C0}=0A$.

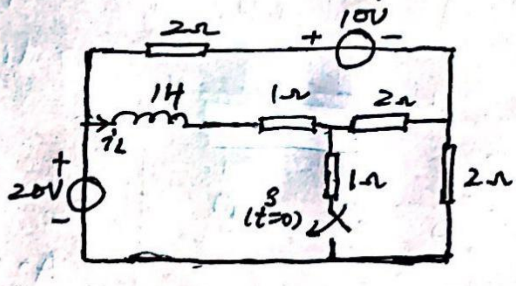
b. $U_{s1}=240\sqrt{2}\cos\omega t$ V时，C与L_2并联谐振，$i_1=0$.
由理想变压器有：$\frac{\dot U_{11}}{\dot U_{21}}=\frac{2}{1}$，$\frac{\dot I_{01}}{\dot I_1}=\frac{1}{2}$ ⇒ $\dot I_{01}=\dot I_1=0A$.
∴ $\dot U_1=\dot U_s=240\angle0°$ V，$\dot U_2=120\angle0°$ V.
$\dot I_{C1}=\frac{\dot U_2}{Z_C}=5\angle90°$ A.

c. $U_{s3}=40\sqrt{2}\cos3\omega t$时，$L_1$、$L_2$、C串联谐振 $\dot U_s=40\angle0°$
$\frac{U_{13}}{U_{23}}=2$，$\frac{\dot I_{03}}{\dot I_3}=\frac{1}{2}$.
$\dot U_s=40\dot I_{03}+\dot U_{13}=40\dot I_{03}+2\dot U_{23}=40\dot I_{03}+20\dot I_3=40\dot I_3$ ⇒ $\dot I_3=1\angle0°A$. $\dot I_{03}=0.5\angle0°A$
由谐振得 $\dot U_{L1}+\dot U_C=0$.
$\dot U_C=-\dot U_{L1}=-\dot I_3 Z_{L1}=9\angle-90°$ V，$\dot I_{C3}=\frac{\dot U_C}{Z_C}=\frac{9}{8}\angle0°$A.

$i(t)=\sqrt{2}\cos3\omega t$ (A)，$I=1A$.
$i_C(t)=5\sqrt{2}\cos(\omega t+90°)+1.125\sqrt{2}\cos3\omega t$ (A)，$I_C=5.125A$.

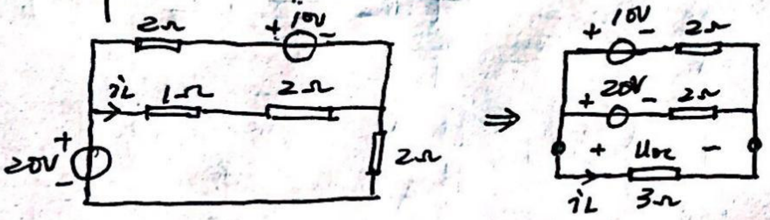
(2)
由(1)得 $U_{s0}=40V$，$I_{00}=\frac{40}{40}=1A$，$\cos\varphi_0=1$. $P_0=U_{s0}I_{00}\cos\varphi_0=40W$.
$U_{s1}=240V$，$I_{01}=0A$，$P_1=U_{s1}I_{01}\cos\varphi_1=0$.
$U_{s3}=40V$，$I_{03}=0.5A$，$\cos\varphi_3=1$. $P_3=U_{s3}I_{03}\cos\varphi_3=20W$.
$P=P_0+P_1+P_3=60W$.

3. 开关闭合前已达到稳态，t=0时闭合，求：(1) $i_L(0_+)$. (2) 换路后流过电感的电流 $i_L(t)$，并作出 $i_L(t)$ 随时间变化的曲线。



(1) 由换路定律 $i_L(0_+)=i_L(0_-)$

作出 $t=0_-$ 稳态时电路图:

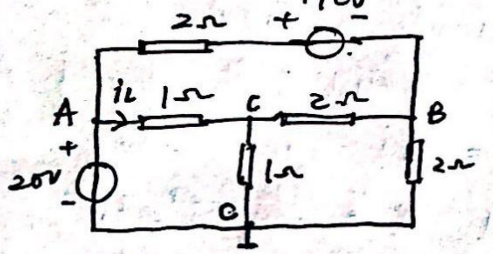


$U_{oc}=15V$，$R_i=1\Omega$.

$i_L(0_-)=\frac{15}{1+3}=3.75A$

$\therefore i_L(0_+)=3.75A$.

(2) 求 $i_L(\infty)$：(节点电压法)　设c的参考节点.

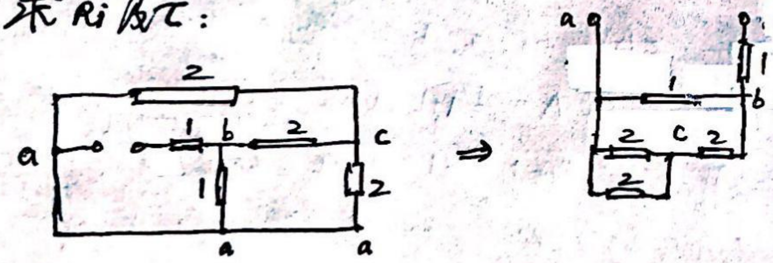


$$\begin{cases} U_A=20V \\ (\frac{1}{2}+\frac{1}{2}+\frac{1}{2})U_B-\frac{1}{2}U_C-\frac{1}{2}\times U_A=-\frac{10}{2} \\ (\frac{1}{2}+1+1)U_C-1\times U_A-\frac{1}{2}\times U_B=0 \end{cases}$$

$U_A=20V$.　$U_B=\frac{25}{7}V$　$U_C=\frac{25}{7}V$

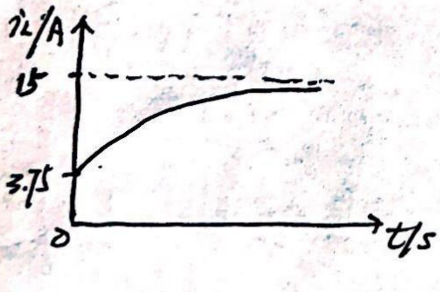
$i_L(\infty)=\frac{U_A-U_C}{1}=15A$.

求 R_i 及 τ:



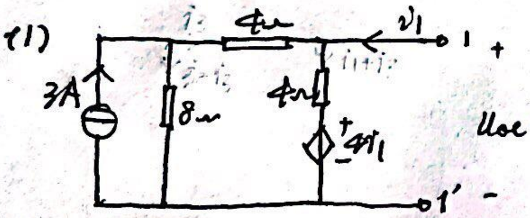
$R_i=1.75\Omega$.　$\tau=\frac{L}{R_i}=\frac{4}{7}s$.

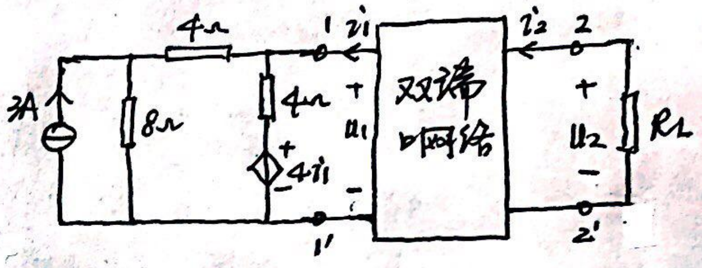
$\therefore i_L(t)=15+(3.75-15)e^{-\frac{t}{\tau}}=15-11.25e^{-1.75t}$ A.



4. 双端口网络Z参数为 $Z_{11}=10\Omega$，$Z_{12}=Z_{21}=8\Omega$，$Z_{22}=12\Omega$. 求 (1) 1-1'端口以左部分的戴维南等效电路；(2) 当 $R_L=4\Omega$ 时求 i_1, i_2, u_1, u_2. (3) $R_L=?$ 时可获 P_{max}.

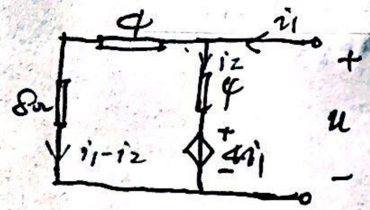
(1)





$i_1=0A$. $u_{oc}=3\times\frac{8}{8+4+4}\times 4=6V$

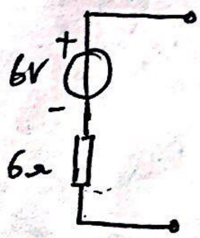
$8i_1=16i_2$



$u=12(i_1-i_2)$

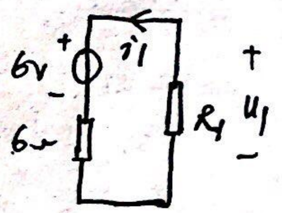
$=4i_2+4i_1 \rightarrow i_2=0.5i_1 \Rightarrow$

$\therefore u=6i_1$ 即 $R_i=6\Omega$.

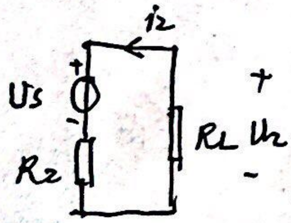


(2)

双端口 $Z=\begin{bmatrix}10 & 8\\ 8 & 12\end{bmatrix} \Rightarrow T=\begin{bmatrix}\frac{5}{4} & 7\\ \frac{1}{8} & \frac{3}{2}\end{bmatrix}$



$R_1=\frac{AR_L+B}{CR_L+D}=6\Omega$. $\begin{cases} i_1=-0.5A \\ u_1=3V. \end{cases}$ ✓



$U_s=\frac{U_{oc}}{CR_i+A}=\frac{6}{\frac{1}{8}\times 6+\frac{5}{4}}=3V.$

$R_2=\frac{DR_i+B}{CR_i+A}=8\Omega$ $\Rightarrow \begin{cases} i_2=-0.25A \\ u_2=1V. \end{cases}$

(3) 由(2)得 $R_L=R_2=8\Omega$ 时

$P_{max}=(\frac{3}{8+8})^2\times 8=0.28W.$