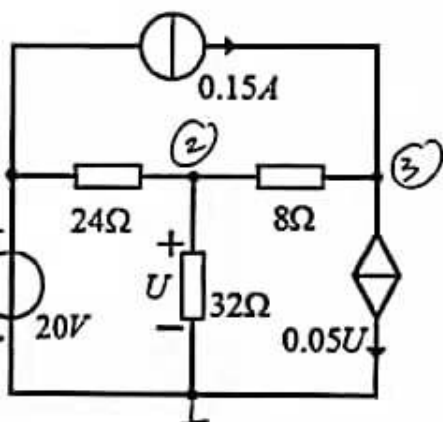


2018-2019电路理论

(10分) 求图示电路中受控源的功率。



$$U_1 = 20$$

$$-\frac{1}{24}U_1 + \left(\frac{1}{24} + \frac{1}{8} + \frac{1}{32}\right)U_2 - \frac{1}{8}U_3 = 0$$

$$-\frac{1}{8}U_2 + \frac{1}{8}U_3 = 0.15 - 0.05U$$

$$U_2 = U$$

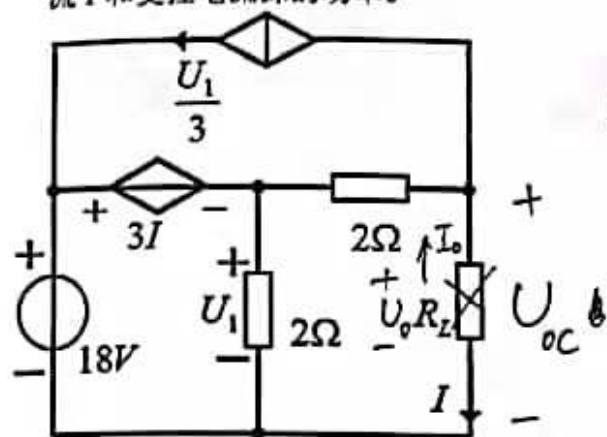
$$19U_2 - 12U_3 = 80$$

$$-3U_2 + 5U_3 = 6$$

$$U_2 = 8V \quad U_3 = 6V$$

$$P = 6 \times 0.05 \times 8 = 2.4W$$

2、(12分) 电路如图示，已知负载 R_L 获得最大功率，求此时的电流 I 和受控电流源的功率。



$$U_{OC} = U_1 - \frac{2}{3}U_1 = \frac{1}{3}U_1$$

$$= \frac{1}{3} \times 18 = 6V$$

$$U_0 = 2(I_0 - \frac{1}{3}U_1) + U_1$$

$$3I + U_1 = 0 \quad I = -I_0 \quad U_1 = 3I_0$$

$$U_0 = 2(I_0 - I_0) + 3I_0 = 3I_0$$

$$R_i = \frac{U_0}{I_0} = 3\Omega \quad R_L = 3\Omega$$

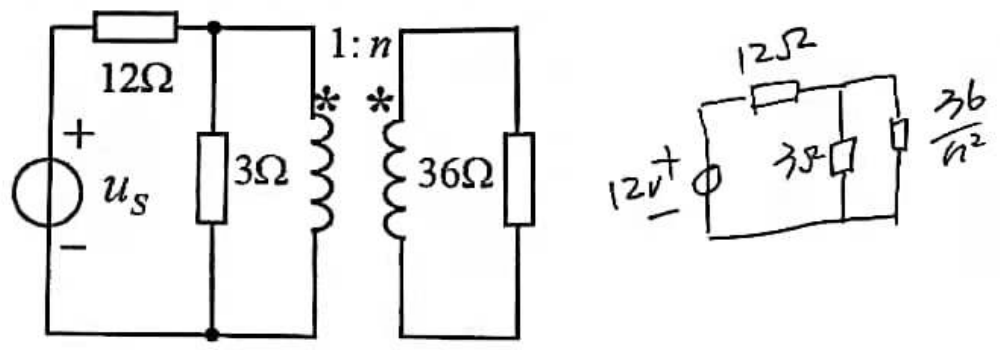
$$P = \frac{36}{4 \times 3} = 3W = I^2 \times 3 \rightarrow I = 1A$$

$$18 = 3I + U_1 = 3 + U_1 \quad U_1 = 15V$$

$$I_{U_1} = 5A$$

$$P = -15 \times 5 = -75W$$

3、(10分) 如图示含理想变压器的电路， $u_s(t) = 12\sqrt{2} \sin \omega t V$ ，已知 3Ω 电阻获得最大功率 P_{max} ，求此时变压器变比 n 及 P_{max} 。

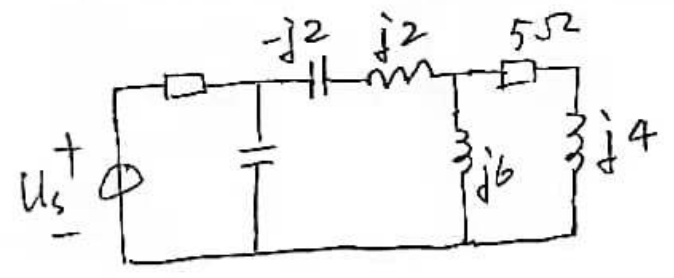
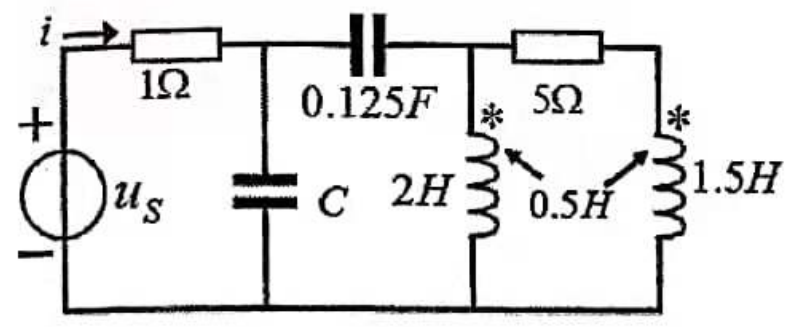


$$12 // \frac{36}{n^2} = 3 \quad n^2 = 9 \quad n = 3$$

$$U_{oc} = \frac{4}{12+4} \times 12 = 3V$$

$$P_{max} = \frac{3^2}{4 \times 3} = \frac{3}{4} W$$

4、(12分) 已知电路中 u_s 与 i 同相， $u_s(t) = 10\sqrt{2} \sin 4t V$ ，求电容 C 的值。

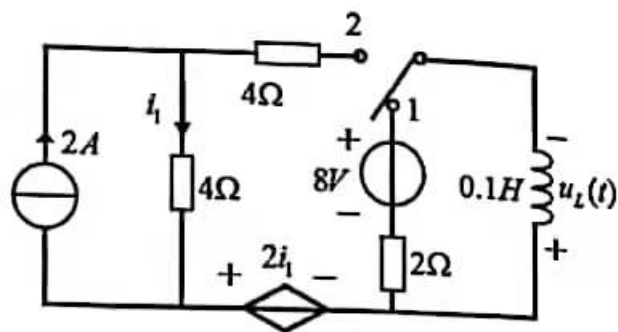


$$Z = \frac{(5 + j4)j6}{5 + j4 + j6} = \frac{-24 + j30}{5 + j10}$$

$$Y = \frac{1}{Z} = \frac{5 + j10}{-24 + j30} = 0.122 - j0.264$$

$$\omega C = 0.264 \quad C = 0.066 F$$

5、(10分) 图示电路开关在位置1时已处于稳态, $t=0$ 时开关S由1合向2, 求 $t \geq 0$ 时的 $u_L(t)$ 。



$$i_L(0^+) = \frac{8}{2} = 4A$$

$$U_{oc} = 4i_1 + 2i_1 = 6i_1 = 12V$$

$$R_i = \frac{U_o}{I_o} = 10\Omega$$

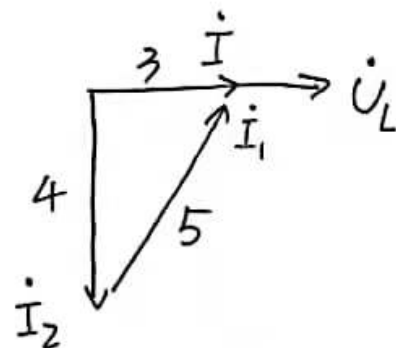
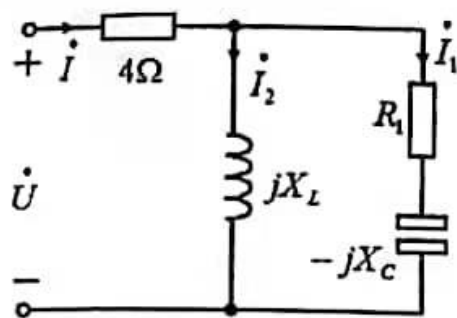
$$i_L(\infty) = 1.2A$$

$$\tau = \frac{0.1}{10} = 0.01s$$

$$i_L(t) = 1.2 + 2.8e^{-100t}$$

$$u_L(t) = -0.1 \frac{di_L}{dt} = 28e^{-100t}$$

6、(12分) 如图所示正弦稳态电路, 已知 $U=52V$, $I_1=5A$, $I_2=4A$, $I=3A$, 求 R_1 , X_L , X_C 和电感的无功功率。



$$U_L = 52 - 12 = 40V$$

$$X_L = \frac{40}{4} = 10\Omega$$

$$I_1 = 5 \angle 53.1^\circ$$

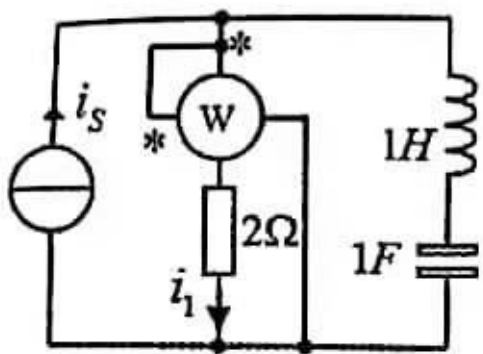
$$\frac{40 \angle 0^\circ}{5 \angle 53.1^\circ} = 8 \angle -53.1^\circ = 4.8 - j6.4$$

$$R_1 = 4.8\Omega \quad X_C = 6.4\Omega$$

$$Q_L = 4^2 \times 10 = 160 \text{ Var}$$

7. (10分) 如图所示电路, 已知

$i_s = 10 + 15\sqrt{2}\sin t + 10\sqrt{2}\sin(2t - 30^\circ)A$, 求 I_1 以及 $i_1(t)$ 和功率表的读数。



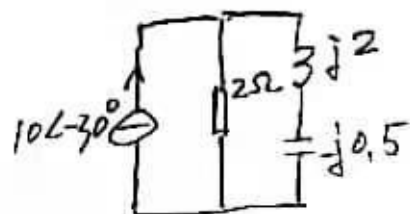
① $10A$ 有效值

$i_1' = 10A$ $P_1' = 200W$

② $15\sqrt{2}\sin t$ 有效值

$i_1'' = 0$ $P_1'' = 0$

③ $10\angle -30^\circ$ 有效值



$$i_1''' = \frac{j1.5}{2+j1.5} \times 10\angle -30^\circ = \frac{j3}{4+j3} \times 10\angle -30^\circ$$

$$= 6\angle 23.2^\circ$$

$P_1''' = 36 \times 2 = 72W$

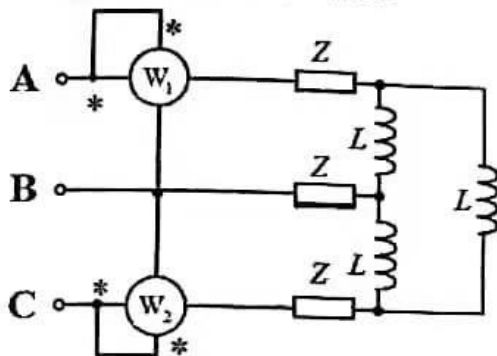
$I_1 = \sqrt{10^2 + 6^2} = 11.66A$ $P = 200 + 72 = 272W$

$i_1(t) = 10 + 6\sqrt{2}\sin(2t + 23.2^\circ)$

8. (12分) 如图为三相电路, 线电压 380V, $Z = 22 - j64\Omega$, $L = \frac{3}{\pi}H$

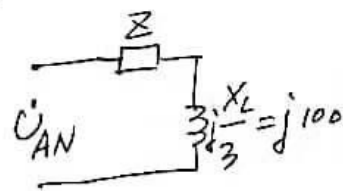
(1) 求电感上的电流的有效值;

(2) 求功率表 W_1 和 W_2 的读数。



$$X_L = 2\pi fL = 100\pi \times \frac{3}{\pi} = 300\Omega$$

$\dot{U}_{AN} = 220\angle 0^\circ$



$$\dot{I}_A = \frac{220\angle 0^\circ}{22 - j64 + j100} = \frac{220}{22 + j36} = 5.2\angle -58.6^\circ$$

$\dot{I}_C = 5.2\angle 61.4^\circ$

① $I_L = \frac{5.2}{\sqrt{3}} = 3A$

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

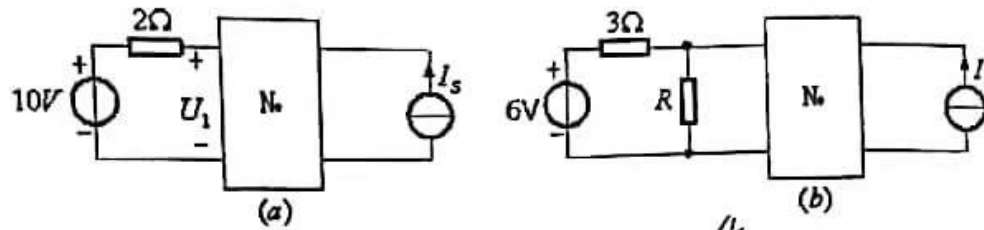
② $P_{W1} = U_{AB} \cdot I_A \cos \phi_1 = 380 \times 5.2 \times \cos(30^\circ + 58.6^\circ) = 48.2W$

$\dot{U}_{CB} = 380\angle 90^\circ$

$P_{W2} = U_{CB} \cdot I_C \cos \phi_2 = 380 \times 5.2 \times \cos(90^\circ - 61.4^\circ) = 1734.9W$

题号	1	2	3	4	5	6	7	8	9	总分
题分	10	10	10	10	10	12	12	14	12	100
得分										

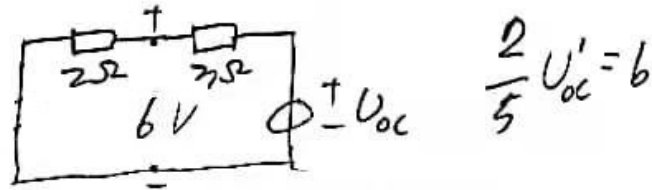
9、(12分) 在图(a)、(b)所示电路中, N_0 为同一不含独立电源的电阻性网络, 已知当 $I_S=0$ 时, $U_1=6V$; 当 $I_S=3A$ 时, $U_1=12V$ 。求图(b)电路中的 $I_S=6A$ 时, R 为何值其获得最大功率 P_{max} , 并求出 P_{max} 。



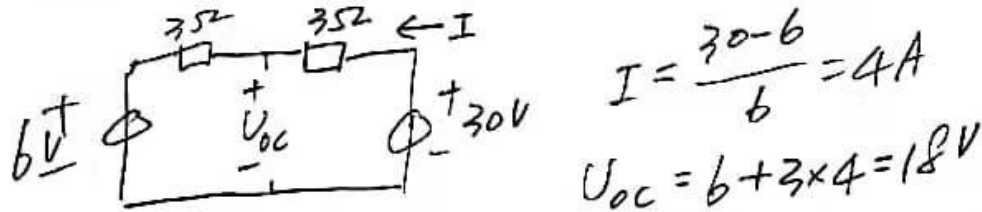
$$I_S=0 \quad U_1=6V \quad 10-6=4V \quad I=\frac{4}{2}=2A$$

$$R_2=\frac{6}{2}=3\Omega$$

$$I_S=3A. \quad U_1=12V. \quad I_S \text{ 等效为 } 6V$$

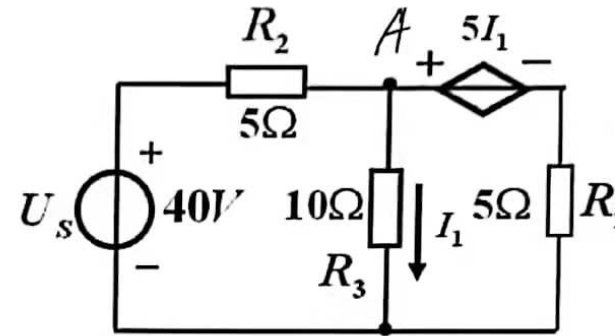


$$U'_{oc}=15V. \quad I_S=6A. \quad U''_{oc}=30V$$



$$R_2=1.5\Omega \quad P_{max}=\frac{18^2}{4 \times 1.5}=54W$$

(10分) 求如图所示电路中受控源的功率。



$$\left(\frac{1}{5} + \frac{1}{5} + \frac{1}{10}\right) U_A = \frac{40}{5} + \frac{5I_1}{5}$$

$$\frac{1}{2} U_A = 8 + I_1$$

$$10I_1 = U_A$$

$$I_1=2A$$

$$U_A=20V$$

$$I_2 = \frac{U_A - 5I_1}{5} = 2A$$

$$P = 5I_1 \times 2 = 20W$$

2、(10分) 应用叠加定理求图示电路中的 U 。

① $3A$ 单独作用

$$U' = -3 \times \frac{2}{18} \times \frac{1}{5} \times 40 = -\frac{24}{9} V$$

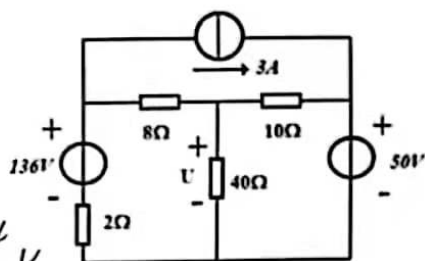
② $136V$

$$U'' = 136 \times \frac{8}{18} = \frac{544}{9} V$$

③ $50V$

$$U''' = 50 \times \frac{8}{18} = \frac{200}{9}$$

$$U = -\frac{24}{9} + \frac{544}{9} + \frac{200}{9} = 80V$$



3、(10分) 用节点分析法求图示电路中受控源的功率。

$$(1 + \frac{1}{2})U_A - \frac{1}{2}U_B = -4$$

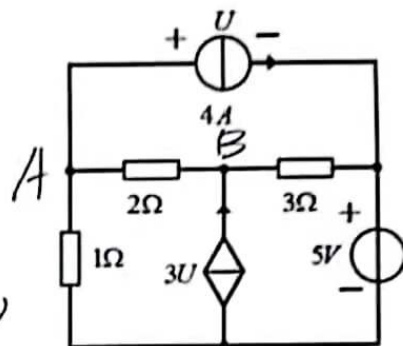
$$-\frac{1}{2}U_A + (\frac{1}{2} + \frac{1}{3})U_B - \frac{1}{3}U_C = 3V$$

$$U_C = 5V$$

$$U_A - U_C = U$$

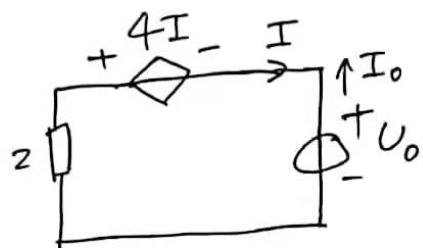
$$U_A = 20V \quad U = 15V$$

$$P = 15 \times 4 = 60W$$



4、(10分) 电路如图所示，负载 R_L 等于多少可以获得最大功率，并求此最大功率。

$$U_{oc} = 2 \times 4 + 8 = 16V$$

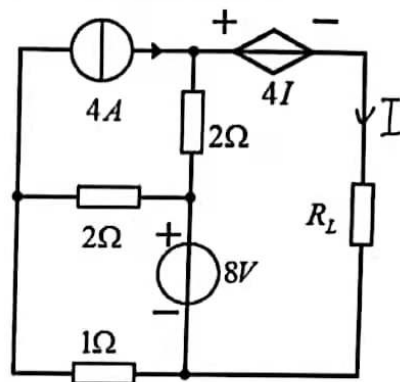


$$2I + 4I + U_o = 0$$

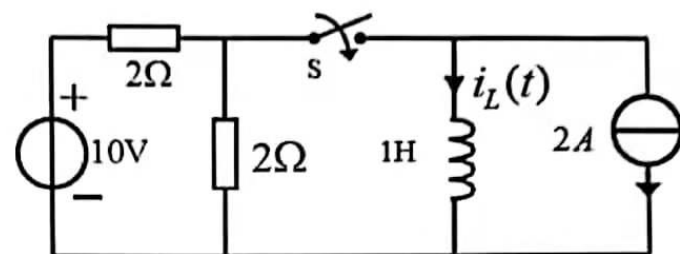
$$6I = -U_o$$

$$R_i = \frac{U_o}{I_o} = -\frac{U_o}{I} = 6\Omega$$

$$P = \frac{16 \times 16}{4 \times 6} = \frac{32}{3} W = 10.67 W$$



5、(10分) 图示电路已处于稳态， $t=0$ 时开关 S 关闭，求 $t \geq 0$ 时的 $i_L(t)$ 。



$$i_L(0^+) = -2A$$

$$i_L(\infty) = \frac{10}{2} - 2 = 3A$$

$$\tau = 1s$$

$$i_L(t) = 3 - 5e^{-t}$$

6. (12分) 电路如图所示, 为使 R 获得最大功率, 求 n 及此最大功率。

① 求 \dot{U}_{oc} 断开 R

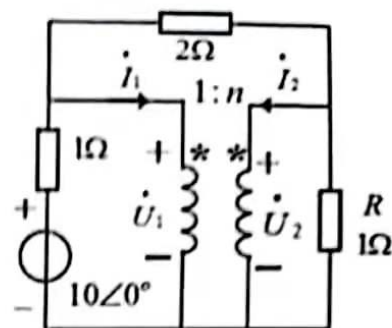
$$n\dot{U}_1 = \dot{U}_2 \quad \dot{I}_1 = -n\dot{I}_2$$

$$\dot{U}_{oc} = \dot{U}_2$$

$$10 = \dot{I}_1 + \dot{I}_2 + \dot{U}_1$$

$$\dot{U}_1 = 2\dot{I}_2 + \dot{U}_2$$

$$\dot{U}_{oc} = \frac{20n}{(1-n)^2 + 2}$$



② 求 \dot{I}_{sc}

$$n\dot{U}_1 = \dot{U}_2 \quad \dot{I}_1 = -n\dot{I}_2$$

$$\dot{U}_2 = 0 \quad 10 = \dot{I}_1 + \dot{I}_2 + \dot{I}_{sc} + \dot{U}_1$$

$$\dot{U}_1 = 0 \quad \dot{U}_1 + 2(\dot{I}_2 + \dot{I}_{sc}) = 0$$

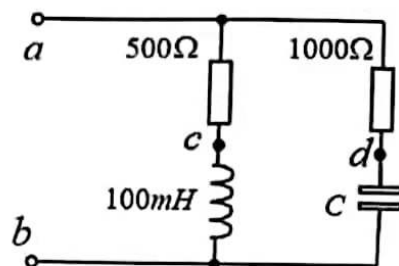
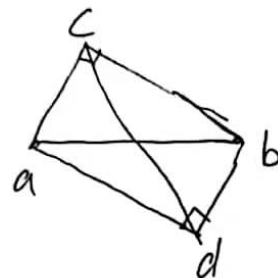
$$\dot{I}_1 = 10 \quad \dot{I}_2 = -\frac{10}{n} \quad \dot{I}_{sc} = \frac{10}{n}$$

③ $Z = \frac{\dot{U}_{oc}}{\dot{I}_{sc}} = \frac{20n}{(1-n)^2 + 2} \times \frac{n}{10} = 1.52 \rightarrow n = 1$

$$\dot{U}_{oc} = 10V$$

$$P = \frac{10 \times 10}{4 \times 1} = 25W$$

7. (12分) 如图所示正弦稳态电路, 已知 $\omega = 100\text{rad/s}$, $U_{ab} = U_{cd}$, 求电容 C 的值。



$$U_{ab} = U_{cd}$$

$$U_{ac} = U_{db}$$

$$U_{cb} = U_{ad}$$

$$\omega L = 10$$

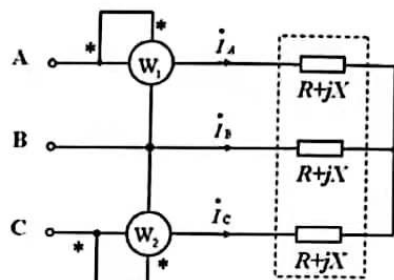
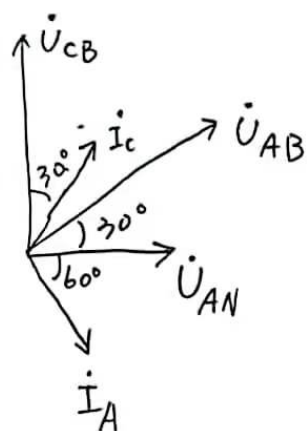
$$\frac{U_{ac}}{U_{cb}} = \frac{U_{db}}{U_{ad}}$$

$$\frac{500}{10} = \frac{X_c}{1000}$$

$$X_c = 5 \times 10^4$$

$$C = \frac{1}{\omega X_c} = \frac{1}{10^2 \times 5 \times 10^4} = 0.2\mu F$$

8. (14分) 图示为对称三相电路, 已知线电压为 380V, 两功率表的读数分别为: $P_1=0$, $P_2=1.65\text{KW}$, 求负载的阻抗参数 $R+jX$.



功率因数 $\cos\varphi = \cos 60^\circ = 0.5$

$3 \times 380 \times I_C \cos 30^\circ = 1650$

$I_A = I_B = I_C = 5\text{A}$

$|Z| = \frac{220}{5} = 44\Omega$

$Z = 44 \angle 60^\circ = 44 \cos 60^\circ + j 44 \sin 60^\circ$
 $= 22 + j 38 \Omega$

分数	
评卷人	

九. (12分) 如图所示电路, 已知

$i_s = 10 + 15\sqrt{2} \sin t + 10\sqrt{2} \sin(2t - 30^\circ)\text{A}$, 求图中电流表和电压

表的读数及 $i_1(t)$.

① 直流

$A_0 = 0 \quad V_0 = 0$

② 基波

$A_1 = 15\text{A} \quad V_1 = 15\text{V}$

③ 二次谐波

$j\omega L = 2$

$\frac{1}{j\omega C} = -j1.5$

$\dot{I}_1(2) = \frac{2}{2 + j1.5} \times 10 \angle -30^\circ = 8 \angle -66.87^\circ$

$A_2 = 8\text{A} \quad V_2 = 16\text{V}$

$A = \sqrt{15^2 + 8^2} = 17\text{V}$

$V = \sqrt{15^2 + 16^2} = 21.9\text{V}$

$i_1(t) = 15\sqrt{2} \sin t + 8\sqrt{2} \sin(2t - 66.87^\circ)$



华中科技大学 2020~2021 学年第一学期

“电路理论 (64 学时)” 考试试卷(A 卷)

考试方式: 闭卷 考试日期: 2021.01.10 考试时长: 150 分钟

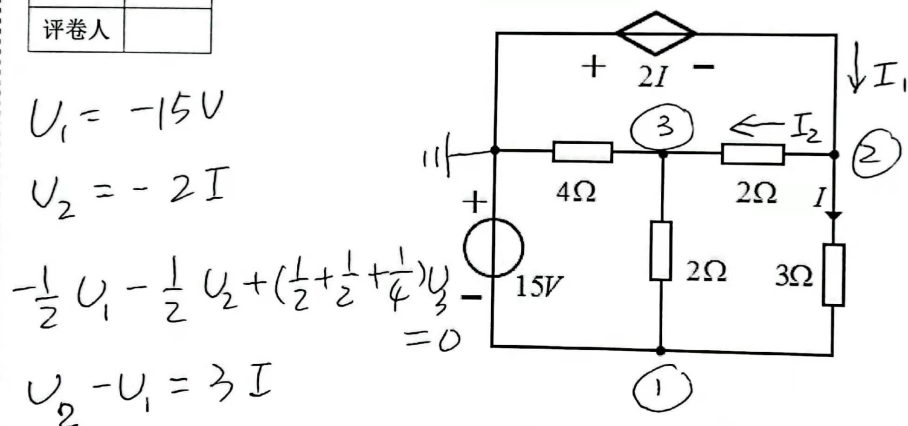
院(系): _____ 专业班级: _____

学 号: _____ 姓 名: _____

题号	一	二	三	四	五	六	七	八	九	总分
分数										

分 数	
评卷人	

一、(10 分) 求如图所示电路中受控源的功率。



$$U_1 = -15V$$

$$U_2 = -2I$$

$$-\frac{1}{2}U_1 - \frac{1}{2}U_2 + (\frac{1}{2} + \frac{1}{2} + \frac{1}{4})U_3 = 0$$

$$U_2 - U_1 = 3I$$

$$U_1 = -15V$$

$$U_2 = -6V$$

$$U_3 = -8.4V$$

$$I = 3A$$

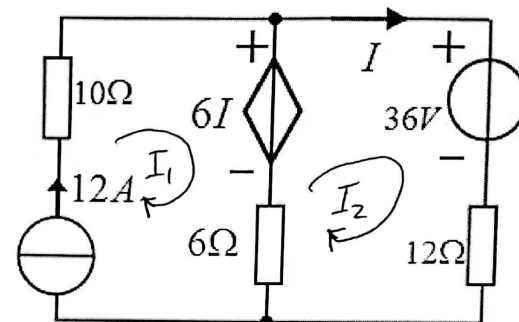
$$I_2 = \frac{U_2 - U_3}{2} = 1.2A$$

$$I_1 = I_2 + I = 4.2A$$

$$P = 2 \times 3 \times 4.2 = 25.2W$$

分 数	
评卷人	

二、(10 分) 应用叠加定理求图示电路中的电压 I 。



$$\textcircled{1} 12A$$

$$I_1 = 12$$

$$I_2 = I$$

$$-6I_1 + 18I_2 = 6I$$

$$I = 6A \quad \text{即 } I' = 6A$$

$$\textcircled{2} 36V$$

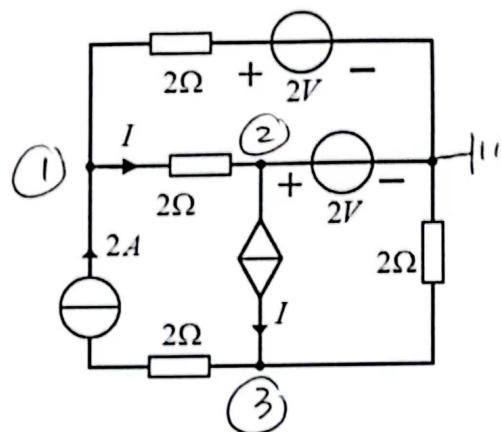
$$36 + 18I = 6I$$

$$I = -3A \quad \text{即 } I'' = -3A$$

$$I = I' + I'' = 6 - 3 = 3A$$

分 数	
评卷人	

三、(10分) 用节点分析法求图示电路中受控源的功率。



$$U_1 - \frac{1}{2}U_2 = 3$$

$$U_2 = 2$$

$$\frac{1}{2}U_3 = I - 2$$

$$U_1 - U_2 = 2I$$

解出:

$$U_1 = 4V$$

$$U_2 = 2V$$

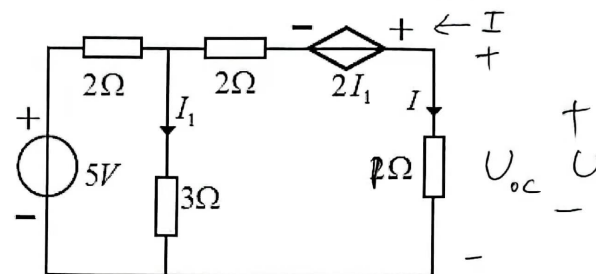
$$U_3 = -2V$$

$$I = 1A$$

$$P = (U_2 - U_3)I = 4W$$

分 数	
评卷人	

四、(10分) 电路如图所示, 请用戴维南定理求电路中的电流 I 。



① 求 U_{oc}

$$U_{oc} = 2I_1 + 3I_1 = 5I_1 = 5V$$

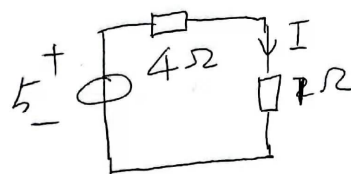
$$I_1 = 5 / (3 + 2) = 1A$$

② 求 I

$$U = 2I_1 + 2I + \frac{6}{5}I$$

$$I_1 = \frac{2}{5}I$$

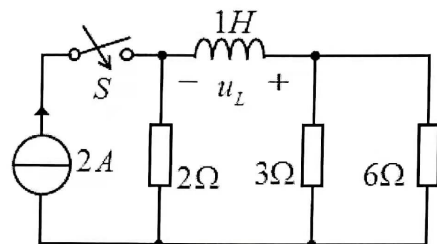
$$U = 4I \quad R_i = 4\Omega$$



$$I = \frac{5}{5} A = 1A$$

分 数	
评卷人	

五、(10分) 图示电路已处于稳态， $t=0$ 时开关S接通，求 $t \geq 0$ 时的 $u_L(t)$ 。



$$① \quad i_L(0^+) = 0$$

$$② \quad i_L(\infty) = 1A$$

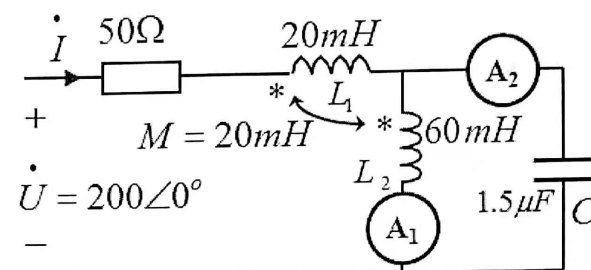
$$③ \quad \tau = \frac{1}{4} s$$

$$i_L(t) = 1 - 1 \times e^{-4t}$$

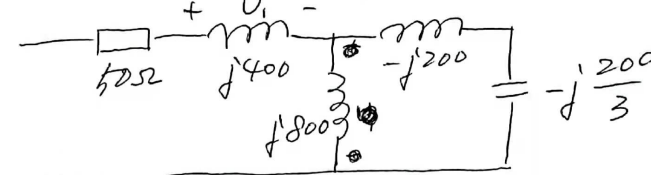
$$u_L(t) = -L \cdot \frac{di_L(t)}{dt} = -4e^{-4t}$$

分 数	
评卷人	

六、(12分) 电路如图所示，求电路的有功功率和两个电流表的读数。



$$\omega = 10^4 \text{ rad/s}$$



串联部分
阻抗

$$Z_1 = j800 \parallel -j\frac{800}{3} = -j400 \quad \text{串联谐振}$$

$$I = \frac{200}{50} = 4A$$

$$P = 4^2 \times 50 = 800W$$

$$U_1 = 4 \times 400 = 1600V$$

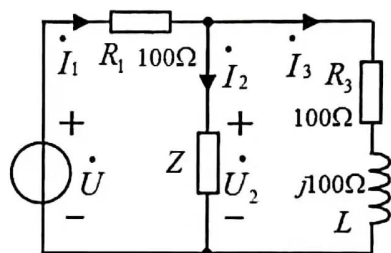
$$I_1 = \frac{1600}{800} = 2A$$

$$I_2 = \frac{1600}{200/3} = 6A$$

分 数	
评卷人	

七、(12 分) 如图所示正弦稳态电路, 已知并联部分有功功率为 100W, 并联部分功率因数 $\cos \varphi = \frac{\sqrt{2}}{2}$ (容性),

$\dot{U}_2 = 100\sqrt{2} \angle 0^\circ$, 求复阻抗 Z 。



$$\cos \varphi = \frac{\sqrt{2}}{2}$$

$$\varphi = 45^\circ$$

\dot{I}_1 超前 \dot{U}_2 45°

$$P = U_2 I_1 \cos \varphi \quad 100 = 100\sqrt{2} I_1 \frac{\sqrt{2}}{2}$$

$$I_1 = 1 \text{ A} \quad \dot{I}_1 = 1 \angle 45^\circ$$

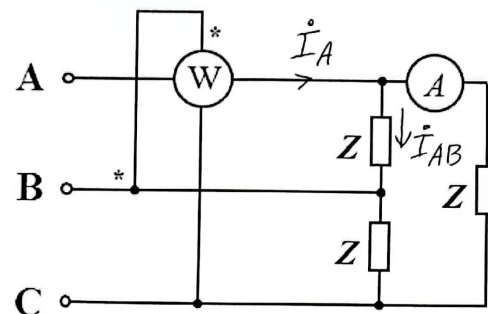
$$\dot{I}_3 = \frac{\dot{U}_2}{100 + j100} = 1 \angle -45^\circ$$

$$\dot{I}_2 = \dot{I}_1 - \dot{I}_3 = \sqrt{2} \angle 90^\circ$$

$$Z = \frac{\dot{U}_2}{\dot{I}_2} = \frac{100\sqrt{2}}{\sqrt{2} \angle 90^\circ} = -j100$$

分 数	
评卷人	

八、(14 分) 图示为正弦稳态三相电路, 已知线电压为 380V, 功率表的读数为 3009.6W, 电流表的读数为 7.6A, 求负载 Z 。



$$\dot{U}_{AB} = 380 \angle 0^\circ$$

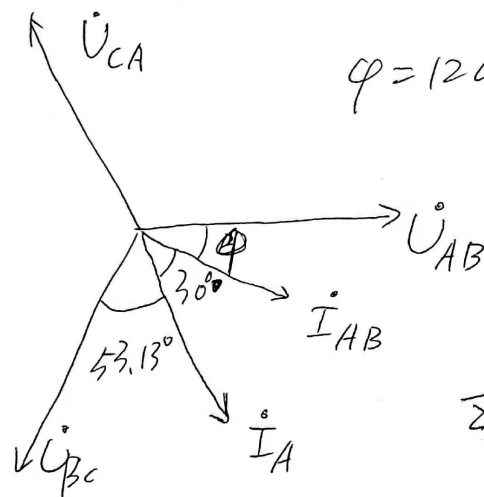
$$|Z| = \frac{380}{7.6} = 50 \Omega$$

$$I_A = 7.6\sqrt{3} \text{ A}$$

$$3009.6 = 380 \times 7.6\sqrt{3} \cos(\dot{U}_{BC}, \dot{I}_A)$$

$$\cos(\dot{U}_{BC}, \dot{I}_A) = 0.6 \quad (\dot{U}_{BC}, \dot{I}_A) = 53.13^\circ$$

$$\varphi = 120^\circ - 53.13^\circ - 30^\circ = 36.87^\circ$$



$$Z = 50 \angle 36.87^\circ = 40 + j30$$

分 数	
评卷人	

九、(12分) 如图所示电路, 已知

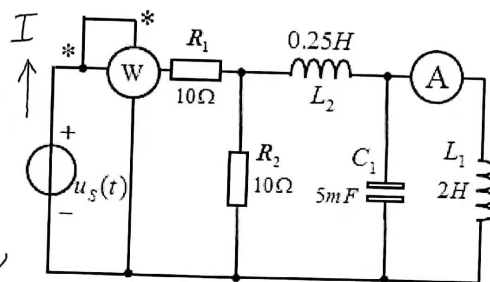
$u_s = [100 + 200\sqrt{2}\sin 10t + 100\sqrt{2}\sin 30t] \text{ V}$, 求图中功率表和电流表的读数。

① 100 V 直流

$$I(0) = 10 \text{ A}$$

$$A(0) = 10 \text{ A}$$

$$P(0) = 10^2 \times 10 = 1000 \text{ W}$$



② 基波 C, L 并联 $\omega_1 L_1 = 20 \Omega$

$$I(1) = \frac{200}{20} = 10 \text{ A} \quad P(1) = 10^2 \times 20 = 2000 \text{ W}$$

$$A(1) = \frac{100}{20} = 5 \text{ A}$$

③ 三次谐波 $\omega_3 L_2 = 7.5 \Omega$ $j\omega_3 L_1 \parallel \frac{1}{j\omega_3 C_1} = -j7.5 \Omega$

$$\text{串联} \quad I(3) = \frac{100}{10} = 10 \text{ A} \quad P(3) = 10^2 \times 10 = 1000 \text{ W}$$

$$A(3) = \frac{10 \times 7.5}{60} = 1.25 \text{ A}$$

$$P = 1000 + 2000 + 1000 = 4000 \text{ W}$$

$$A = \sqrt{10^2 + 5^2 + 1.25^2} = 11.25 \text{ A}$$