

# “电路理论” 64 学时考试试题 (A 卷)

考试日期: 2015.01.24 (计算机、物联网、软件等专业, 闭卷)

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

示电路中的电流  $I$ 。

文件(F) 视图(V) 工具(T) 帮助(H)

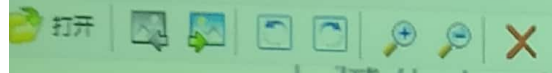
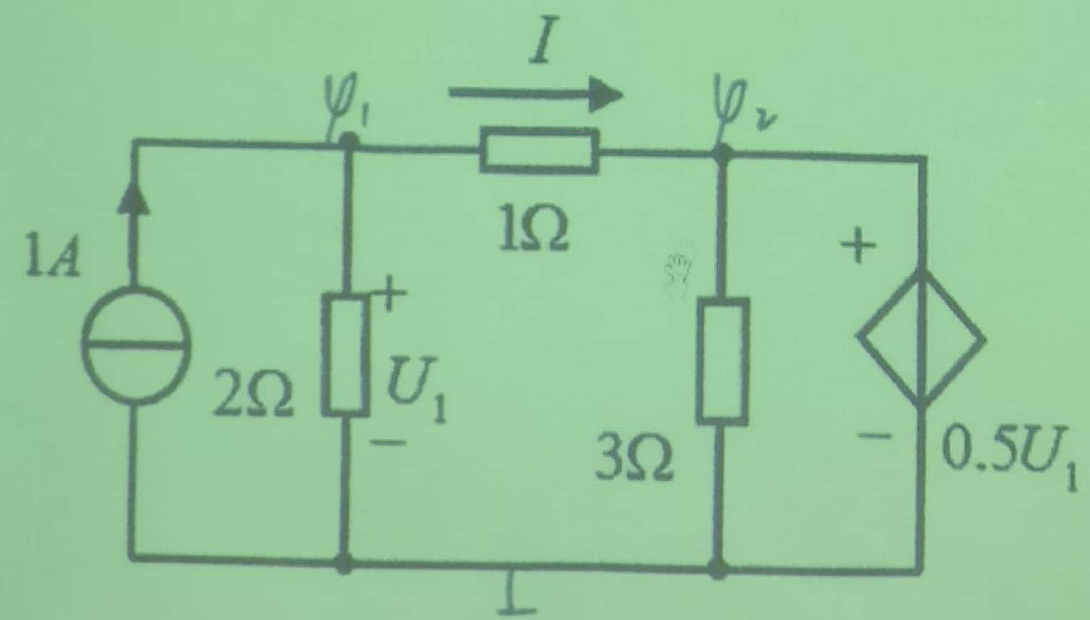


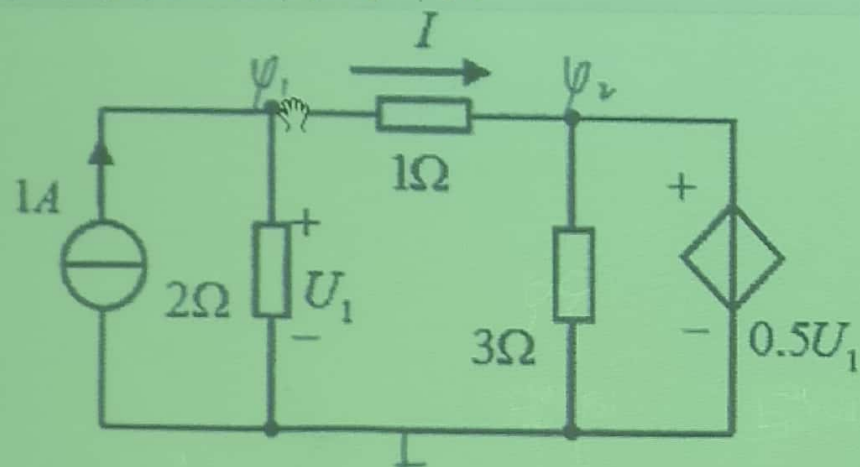
Photo Manager 完整查看器

10分	10	10	10	10	10	12	14	1
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得分	评卷人
10	

1、(10分) 求图示电路中的电流  $I$ 。





解：标结点如图，列结点方程得

$$\begin{cases} \frac{1}{2} + 1) \varphi_1 - \varphi_2 = 1 \\ \varphi_2 = 0.5 U_1 \\ U_1 = \varphi_1 \end{cases}$$

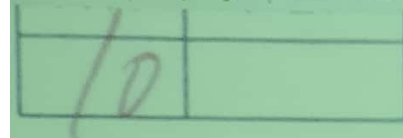
解得  $\varphi_1 = 1 \text{ V}, \varphi_2 = \frac{1}{2} \text{ V}.$

$$I = \frac{\varphi_1 - \varphi_2}{1\Omega} = \frac{1}{2} \text{ A}.$$

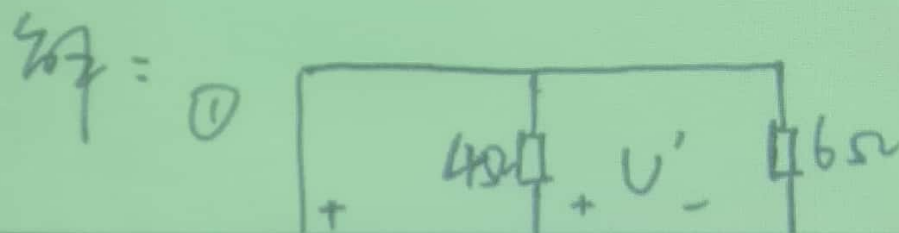
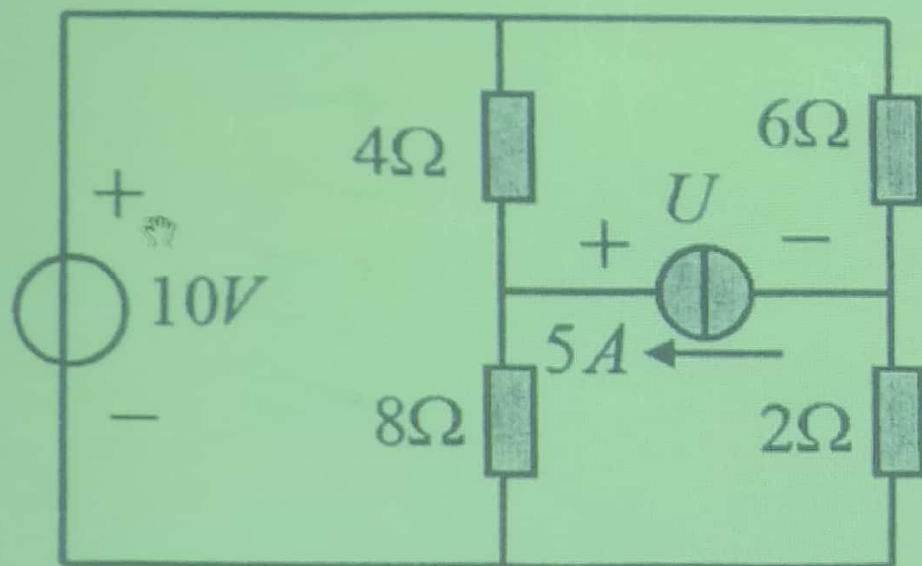
文件(F) 视图(V) 工具(T) 帮助(H)

打开

Photo Manager 完整查看器

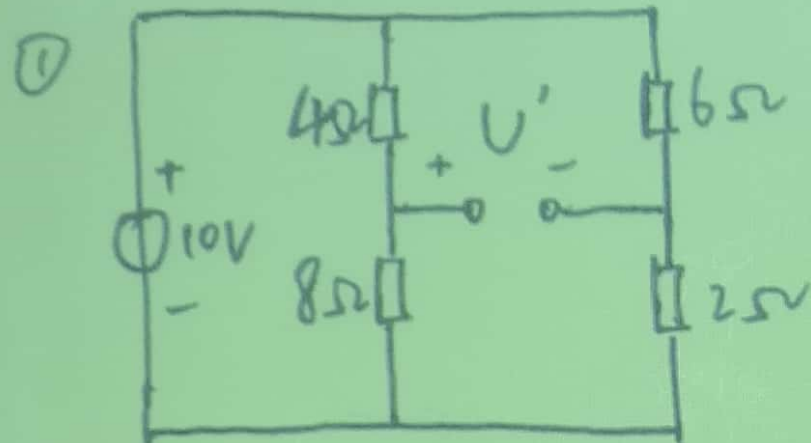


2、(10分) 应用叠加定理求图示电路中的电压  $U$ 。

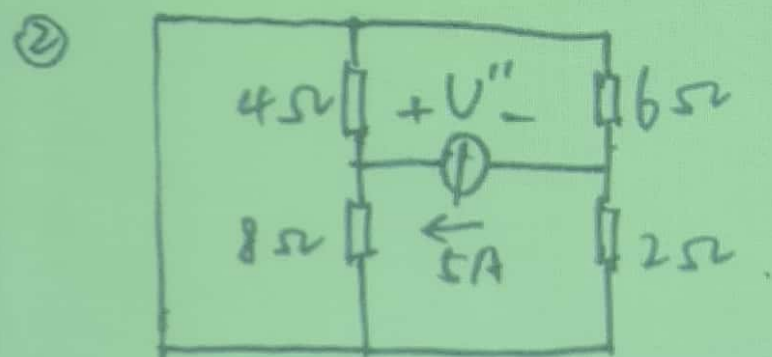


$$U' = \frac{10}{4+8} \times 8 - \frac{10}{6+2} \times 2$$





$$V' = \frac{10}{4+8} \times 8 - \frac{10}{6+2} \times 2 = \frac{25}{6} \text{ V}$$

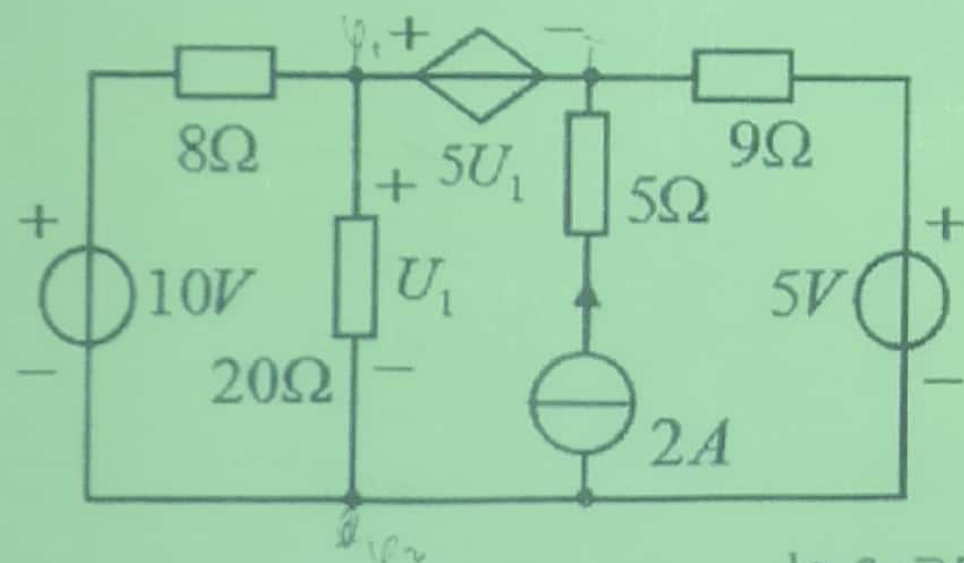


$$V'' = 4 \times \frac{8}{4+8} \times 5 + 2 \times \frac{6}{6+2} \times 5 =$$

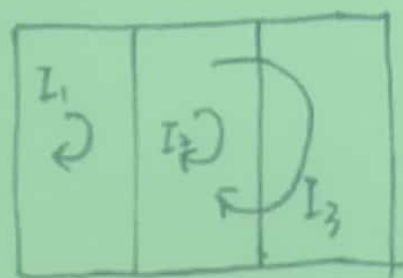
故  $V = V' + V'' = \frac{25}{6} \text{ V} + \frac{125}{6} \text{ V} = \frac{150}{6} \text{ V} = 25 \text{ V}$

得分	评卷人
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3、(10 分) 电路如图所示。(1) 列写回路分析法方程；(2) 列写节点分析法方程（均无需计算只列方程）。



解：(1).



标回路如左图。

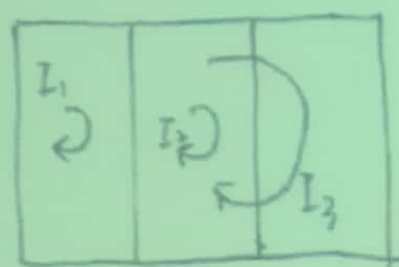
$$28I_1 - 20I_2 - 20I_3 = 10$$

$$I_2 = -2A$$

$$-20I_1 + 20I_2 + 29I_3 = -5U_1 - 5$$



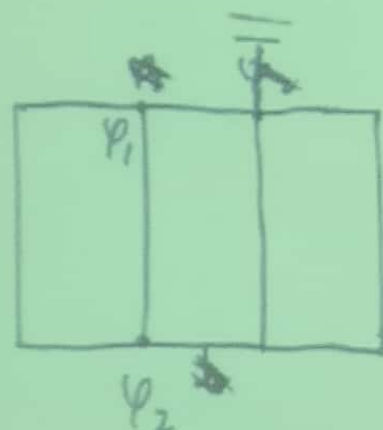
解: (1)



标示回路如左图.

$$\begin{cases} 28 I_1 - 20 I_2 - 20 I_3 = 10 \\ I_2 = -2A \\ -20 I_1 + 20 I_2 + 29 I_3 = -5V_1 - 5 \\ V_1 = (I_1 - I_2) \times 20 \end{cases}$$

12)

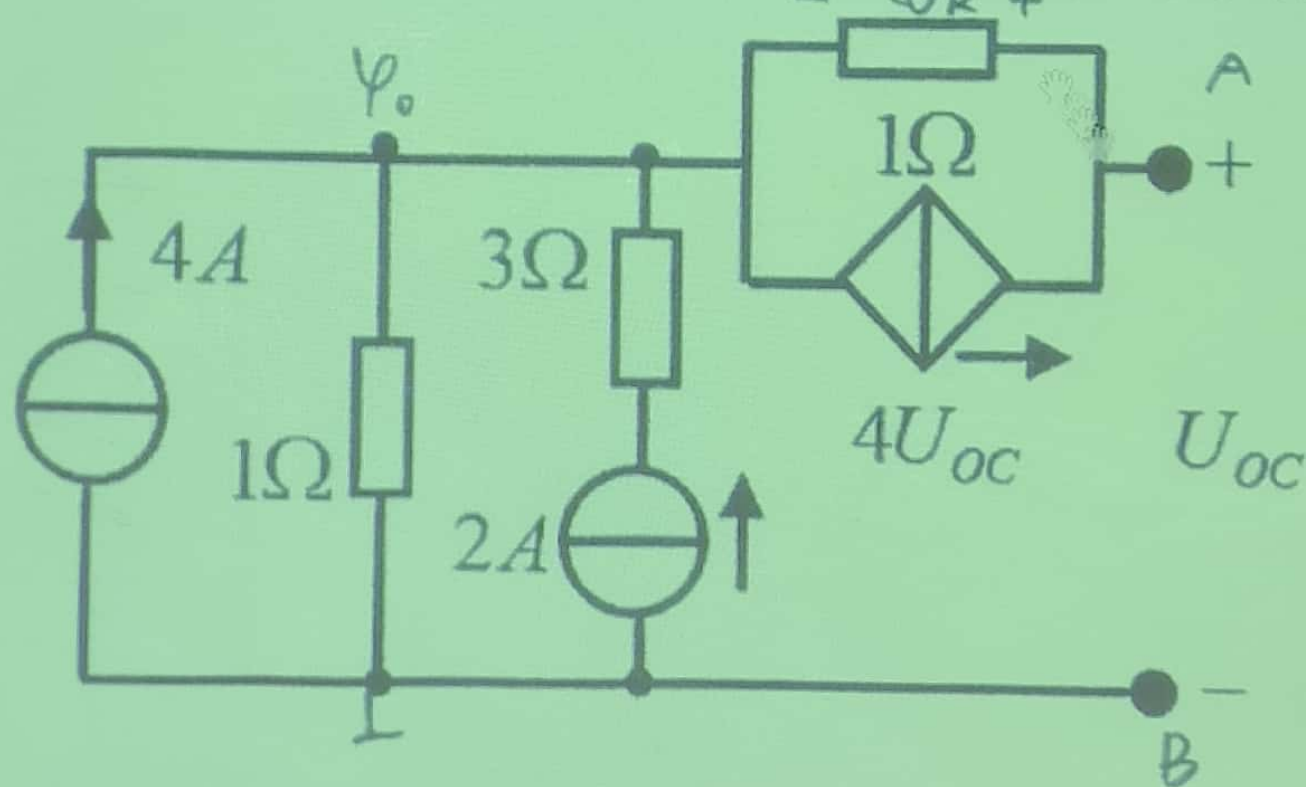


标示节点如左图.

$$\begin{cases} \varphi_1 = 5V_1 \\ -(\frac{1}{20} + \frac{1}{8})\varphi_1 + (\frac{1}{8} + \frac{1}{20} + \frac{1}{9})\varphi_2 = -\frac{10}{8} - 2 - \frac{5}{9} \\ V_1 = \varphi_1 - \varphi_2 \end{cases}$$

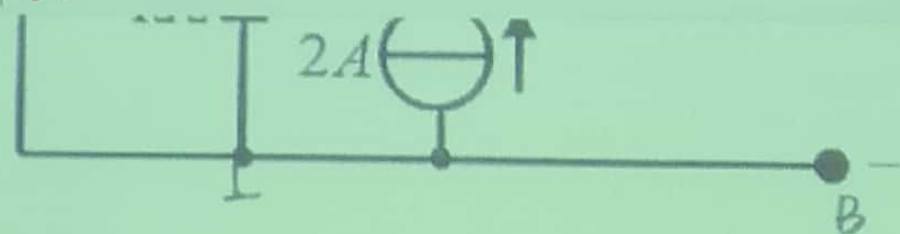
得分	评卷人
10	

4、(10 分) 电路如图所示, 求其戴维南等效电路。



解: 标示节点如图.





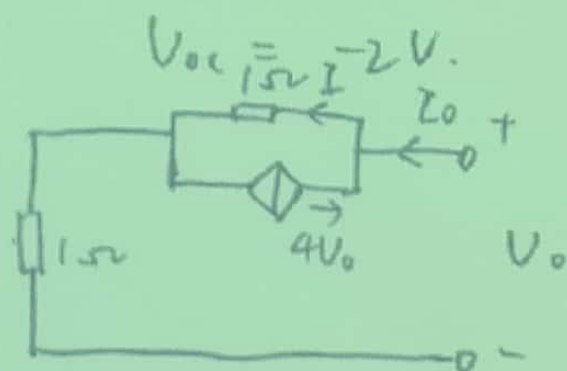
解: 标示节点如图.

$$1 \times \varphi_0 = 4 + 2.$$

$$\varphi_0 = 6V.$$

$$\text{而 } U_R = 4U_0 \times 1\Omega = 4U_0$$

$$\therefore U_0 = U_R + \varphi_0 = 4U_0 + 6V$$

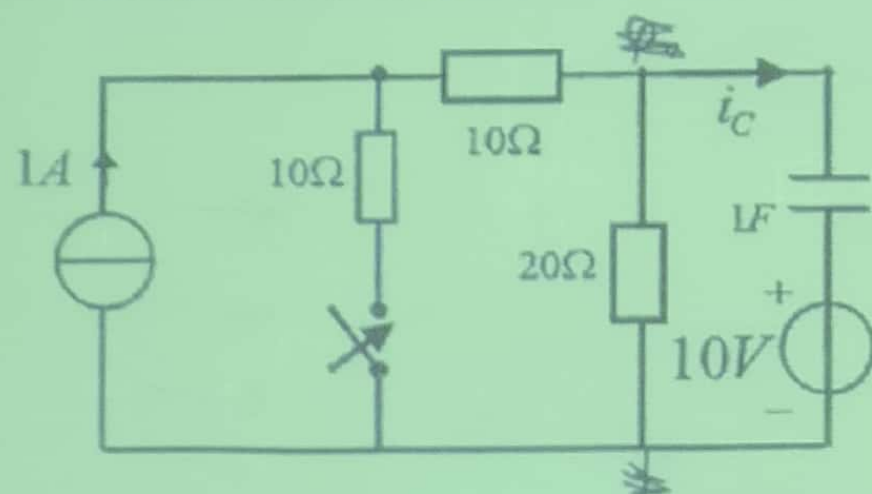


$$\begin{cases} I = I_0 + 4U_0 \\ U_0 = 1 \times I + 1 \end{cases}$$

$$R_{\text{eq}} = \frac{U_0}{I_0} = -\frac{2}{3} \Omega$$

得分	评卷人
10	

5、(10分) 图示电路已处于稳态,  $t=0$  时开关闭合, 求  $t>0$  时的电流  $i_C(t)$ 。

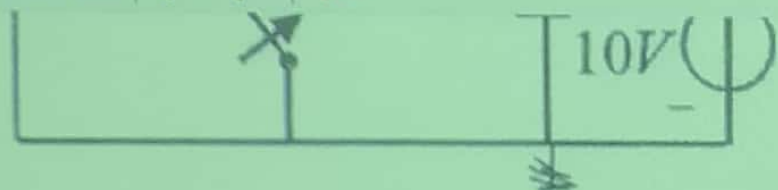


解: 将开关闭合前的电路, 则开合之前有

~~将~~

$$U_C(0^+) = 1 \times 20 - 10 = 10V$$

$$U_C(\infty) = \frac{10}{10+10+20} \times 20 - 10 = -5V$$



解: 将开关在如图, 则闭合之前有

~~将~~

$$u_c(0^+) = 1 \times 20 - 10 = 10 \text{ V.}$$

$$u_c(\infty) = \frac{10}{10+10+20} \times 20 - 10 = -5 \text{ V}$$

等效电阻  $R = (10+10) // 20 = 10 \Omega$ .

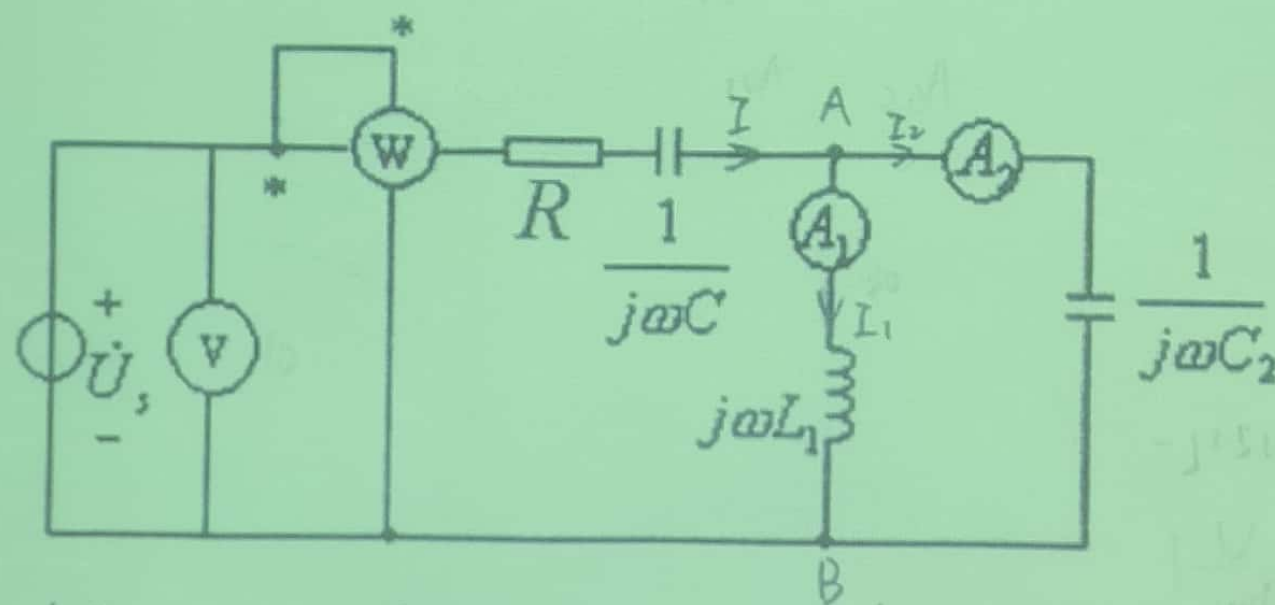
$$\therefore \text{时间常数 } \tau = RC = 10 \text{ s.}$$

$$\therefore u_c(t) = -5 + 15e^{-\frac{t}{10}} \text{ (V).}$$

$$\therefore i_c(t) = \frac{cd u_c(t)}{dt} = -\frac{3}{2} e^{-\frac{t}{10}} \text{ (A).}$$

得分	评卷人

6、(12分) 已知:  $\frac{1}{\omega C_2} = 1.5\omega L_1$ ,  $R = 1\Omega$ ,  $\omega = 10^4 \text{ rad/s}$ , 电压表的读数为  $10 \text{ V}$ , 电流表  $A_1$  的读数为  $3.0 \text{ A}$ 。求图中电流表  $A_2$ , 功率表  $W$  的读数和电路的输入阻抗  $Z_{in}$ 。

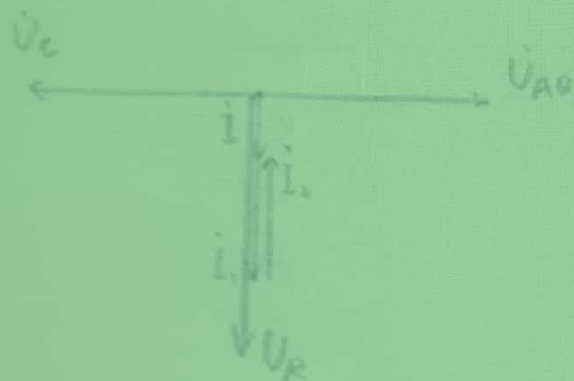


解:  $I_1 = \left| \frac{U_{AB}}{j\omega L_1} \right|$   $I_2 = \left| \frac{U_{AB}}{\frac{1}{j\omega C_2}} \right| = \left| \frac{U_{AB}}{j1.5\omega L_1} \right|$

$$I_1 = \left| \frac{U_{AB}}{j\omega L_1} \right| \quad I_2 = \left| \frac{U_{AB}}{1/j\omega L_2} \right| = \left| \frac{U_{AB}}{j1.5\omega L_1} \right|$$

$$\therefore I_2 = \frac{2}{3} I_1 = 20 \text{ A. 即 } A_2 \text{ 读数为 } 20 \text{ A.}$$

以  $U_{AB}$  为基准作相量图如下:



$$\dot{I}_1 = 30 \angle -90^\circ \text{ A. } \dot{I}_2 = 20 \angle 90^\circ \text{ A. } \dot{I}_3 = \dot{I}_1 + \dot{I}_2 = 10 \angle -90^\circ$$

$$\dot{U}_R = \dot{I}_3 R = 10 \angle -90^\circ \text{ V.}$$

$$\therefore U_R = U_S$$

$$\therefore \dot{U}_C = -\dot{U}_{AB}. \quad \dot{U}_S = \dot{U}_R.$$

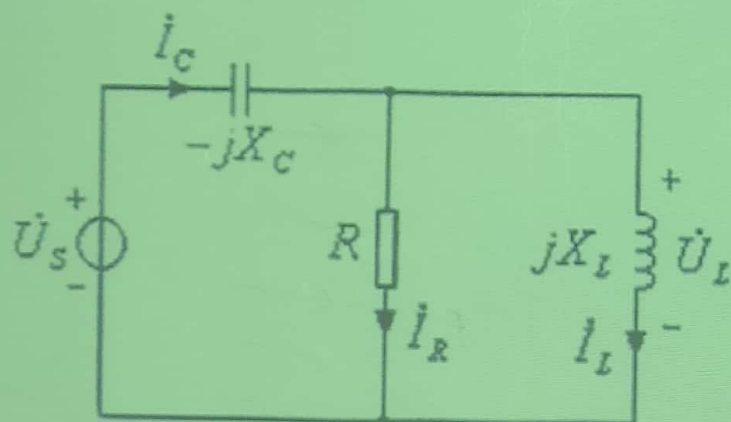
$$\therefore P = U_S \cdot I \cdot \cos(-90^\circ + 90^\circ) = 100 \text{ W}$$

即功率表读数为 100 W.

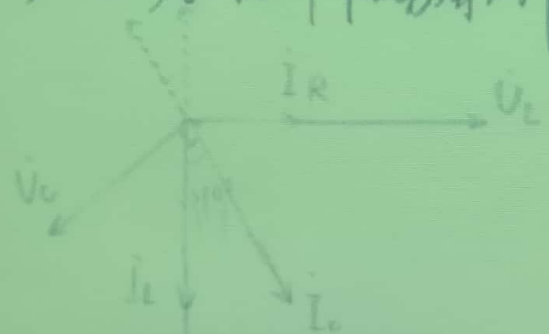
$$Z_{in} = \frac{\dot{U}_S}{\dot{I}} = 1 \Omega$$



7. (14分) 图示电路中, 已知  $I_R = 3A$ ,  $U_S = 9V$ ,  $i_C$  超前  $u_S$  的相位角为  $\varphi = 36.9^\circ$ , 且  $\dot{U}_S$  与  $\dot{U}_L$  正交。求元件参数  $R$ ,  $X_L$  与  $X_C$  的值。



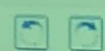
解: 以  $\dot{U}_L$  为基准作相量图如下: (由  $\dot{I}_C = \dot{I}_R + \dot{I}_L$  知  $\dot{U}_S$  领先  $\dot{U}_L 90^\circ$  的情况不可能)



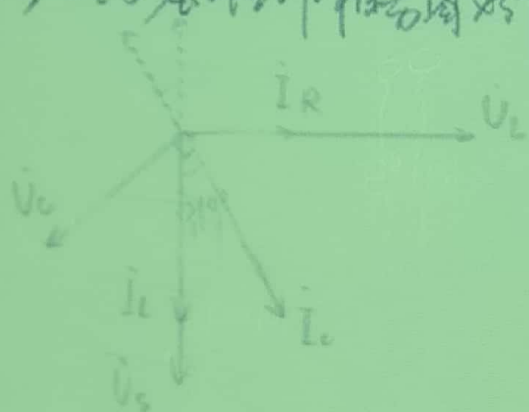
$$\dot{I}_R = 3 \angle 0^\circ A \quad \therefore \dot{I}_C = \dot{I}_R + \dot{I}_L$$

$$\therefore \dot{I}_C = \frac{I_R}{\sin \varphi} \angle -53.1^\circ = 5 \angle -53.1^\circ A$$

$$\dot{I}_L = I_C \cos \varphi \angle -90^\circ = 4 \angle -90^\circ A$$



解: 以  $\dot{U}_L$  为基准作相量图如下: (由  $\dot{I}_C = \dot{I}_R + \dot{I}_L$  知  $\dot{U}_S$  领先  $\dot{U}_L$   $90^\circ$  的情况不可能)



$$\dot{I}_R = 3 \angle 0^\circ \text{ A} \quad \therefore \dot{I}_C = \dot{I}_R + \dot{I}_L$$

$$\therefore \dot{I}_C = \frac{I_R}{\sin \varphi} \angle -53.1^\circ = 5 \angle -53.1^\circ \text{ A}$$

$$\dot{I}_L = I_C \cos \varphi \angle -90^\circ = 4 \angle -90^\circ \text{ A}$$

由  $\dot{U}_C + \dot{U}_L = \dot{U}_S$  知,  $U_C \cos 56.1^\circ = U_S$ , 故  $\dot{U}_C = 15 \angle 56.1^\circ \text{ V}$

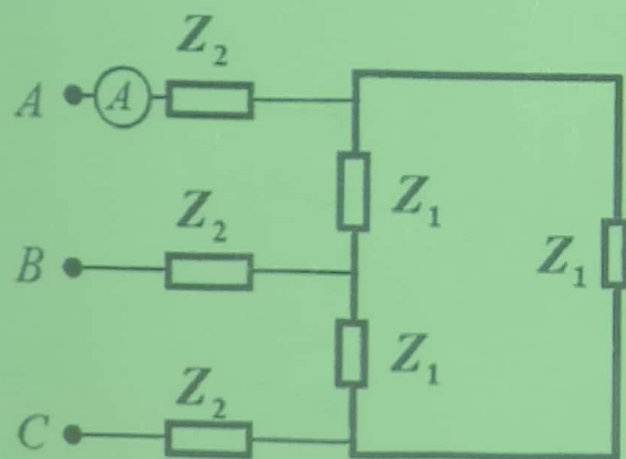
$$U_C \sin 56.1^\circ = U_L, \quad \dot{U}_L = 12 \angle 0^\circ \text{ V}$$

$$R = \frac{U_L}{I_R} = 4 \Omega, \quad X_C = \frac{U_C}{I_C} = 3 \Omega, \quad X_L = \frac{U_L}{I_L} = 3 \Omega$$

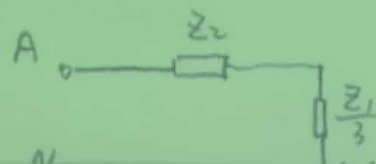


得分	评卷人

8、(12 分) 下图为三相交流电路， $Z_2 = j2\Omega$ ，线电压为 380V，电路总的有功功率为 11616W，电流表 A 的读数为 22A，求负载  $Z_1$  及三相负载  $Z_1$  的无功功率。



解：上题等效于



$$3 \times I_A U_{AN} \cos \varphi = 11616$$

$$\cos \varphi = 0.8 \quad \varphi = 36.9^\circ$$

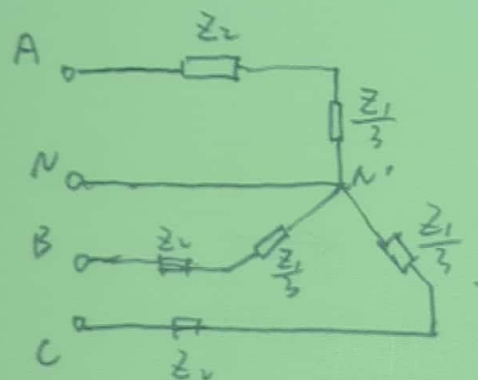
$$|Z_2 + \frac{Z_1}{3}| = U_{AN} = 220V$$

文件(F) 视图(V) 工具(T) 帮助(H)



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7: 上题等效子



$$3 \times I_A V_{AN} \cos \varphi = 11616$$

$$\cos \varphi = \frac{0.8}{\cancel{0.76}} \quad \varphi = \cancel{76.1^\circ}^{36.9^\circ}$$

$$|Z_2 + \frac{Z_1}{3}| = \frac{V_{AN}}{I_A} = \frac{220V}{2A} = 10 \Omega$$

$$\cancel{\operatorname{Re}(Z_2 + \frac{Z_1}{3}) \times \cos 76.1^\circ =}$$

$$10 \times \cos \cancel{76.1^\circ}^{36.9^\circ} = \operatorname{Re}(Z_2 + \frac{Z_1}{3})$$

$$10 \times \sin \cancel{76.1^\circ}^{36.9^\circ} = \operatorname{Im}(Z_2 + \frac{Z_1}{3})$$

$$\text{故 } Z_1 = \cancel{7.2 + j12} \Omega \quad (20 + j12) \Omega$$

$$U_{\frac{Z_1}{3}} = \left| \frac{\frac{Z_1}{3}}{Z_2 + \frac{Z_1}{3}} \right| V_{AN} = \cancel{177.6} 88\sqrt{5} V$$

$$Q_{Z_1} = 3 \times U_{\frac{Z_1}{3}} I_A \sin \arctan \frac{12}{20} = \cancel{1770.6} 5808 \text{ var}$$









$$I' = \frac{U_1'}{R_1 + R_2} = \frac{3V}{1\Omega + 2\Omega} = 1A.$$

$$U' = I' \times R_2 = 2V.$$

$$P' = I' U_1' = 3W.$$

④. 对正弦电流  $u_1(t) = 10\sqrt{2}\sin\omega t$  V.

$$\omega = 2 \text{ rad/s}, \quad \frac{1}{j\omega C} = \frac{1}{j2}, \quad -j2, \quad j\omega L = j2.$$

故  $\frac{1}{j\omega C} + j\omega L = 0$ . C、L 发生谐振

$$I'' = \frac{U_1''}{R_1} = \frac{10V}{1\Omega} = 10A.$$

$$U'' = I'' \times \left| \frac{1}{j\omega C} \right| = 20V.$$

$$P = I''^2 R_1 = 100W.$$

$$\text{故 } I = \sqrt{I'^2 + I''^2} = 10.05A, \quad U = \sqrt{2^2 + 20^2} = 20.10V, \quad P = 103W.$$