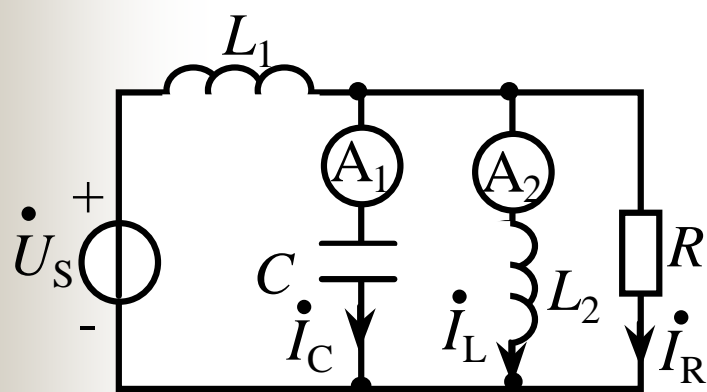


## 习题课

1. 如图所示电路, 已知  $X_{L1} = X_C = R = 10 \Omega$ , 电流表  $\textcircled{A_1}$ ,  $\textcircled{A_2}$  的读数均为  $1\text{A}$ , 设流过电容的电流初相位角为零度, 求  $\dot{U}_S$ 。



解

设  $\dot{I}_C = 1 \angle 0^\circ \text{ A}$

则  $\dot{U}_C = -jX_C \dot{I}_C = -j10 \text{ V}$

$$\dot{I}_R = \frac{\dot{U}_C}{R} = -j \text{ A}$$

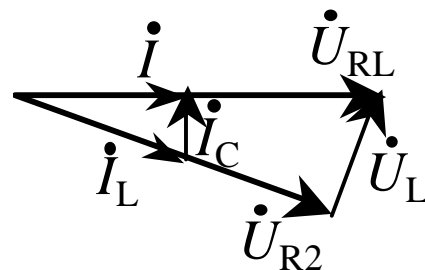
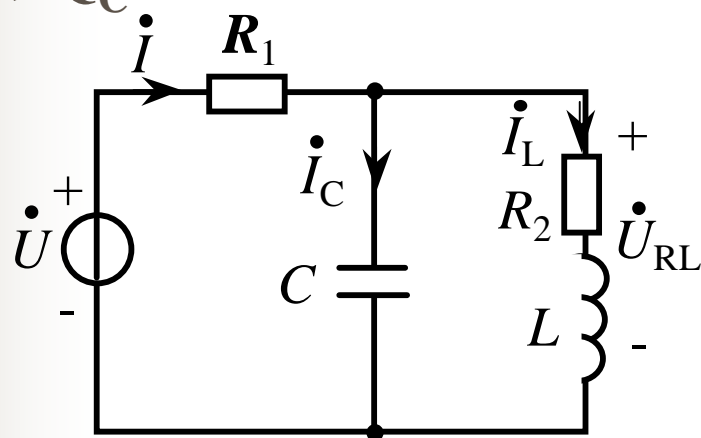
$$\dot{I}_{L1} = \dot{I}_C + \dot{I}_{L2} + \dot{I}_R = \dot{I}_R$$

$$\dot{U}_S = j\omega L_1 \dot{I}_{L1} + \dot{U}_C = j10 \times (-j) - j10$$

$$= 10 - j10 = 10\sqrt{2} \angle -45^\circ \text{ V}$$

2. 电路如图所示,已知  $\dot{U}$  与  $\dot{I}$  同相位,  $R_1=R_2=1\Omega$ ,  $I=3A$ , 电路吸收的有功功率  $P=34W$ ,求  $I_C$  及电容吸收的无功功率  $Q_C$ 。

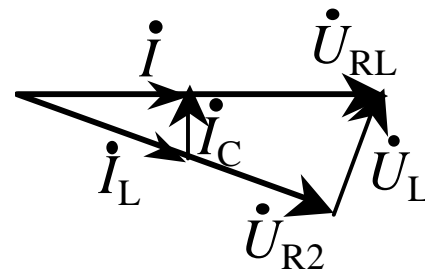
解



由题意, 得  $I^2 R_1 + I_L^2 R_2 = P = 34$  从而, 有  $I_L = 5A$

由相量图, 得  $I_C = \sqrt{I_L^2 - I^2} = 4 A$

由三角形相似，得  $\frac{I}{I_L} = \frac{U_{R2}}{U_{RL}}$



从而，得  $U_{RL} = 25/3 \text{ V}$

所以，有

$$Q_C = I_C \times U_{RL} \sin(-90^\circ) = -33.34 \text{ Var}$$

3. 如图所示电路, 已知,  $\dot{I}_1 = 5\angle 0^\circ \text{ A}$ ,  $I_2 = 5\sqrt{3} \text{ A}$ ,  $X_C = 10\sqrt{3} \Omega$   
当  $\dot{U}_s$  与  $\dot{I}$  同相时, 求  $R_2, X_L$  和  $\dot{U}_s$ 。

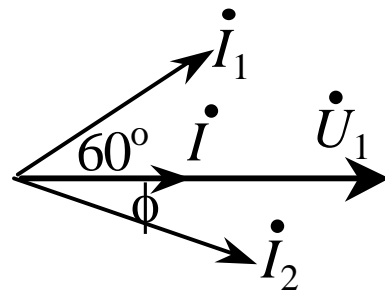
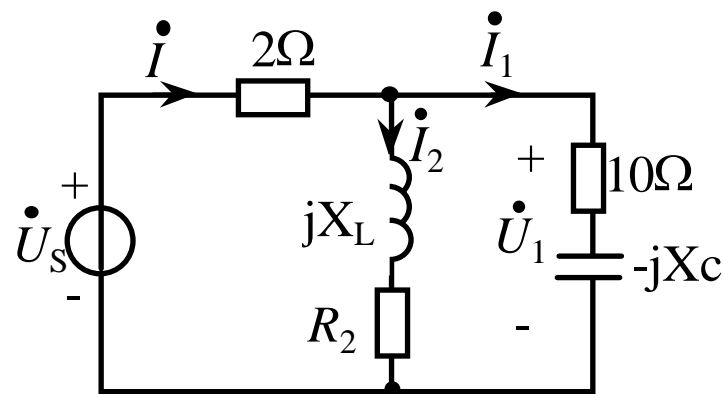
解  $\dot{U}_1 = \dot{I}_1 \times (10 - j10\sqrt{3}) = 100\angle -60^\circ \text{ V}$

$$|R_2 + jX_L| = \frac{100}{5\sqrt{3}} = \frac{20}{\sqrt{3}}$$

由题意,  $\dot{I}$  与  $\dot{U}_1$  也应同相位, 则有

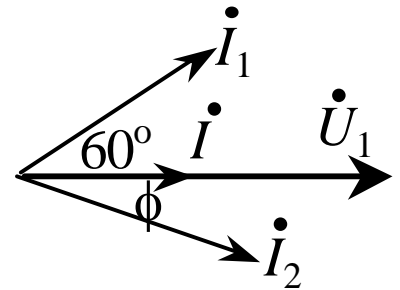
$$I_1 \sin 60^\circ = I_2 \sin \phi$$

即  $5 \sin 60^\circ = 5\sqrt{3} \sin \phi \quad \phi = 30^\circ$



$$R_2 = \frac{20}{\sqrt{3}} \cos 30^\circ = 10 \, \Omega$$

$$X_L = \frac{20}{\sqrt{3}} \sin 30^\circ = \frac{10}{3} \sqrt{3} \, \Omega$$



$$\begin{aligned} \dot{I} &= (I_1 \cos 60^\circ + I_2 \cos 30^\circ) \angle (-60^\circ) \\ &= 10 \angle (-60^\circ) \text{ A} \end{aligned}$$

$$\begin{aligned} \dot{U}_s &= 2\dot{I} + \dot{U}_1 = 20 \angle (-60^\circ) + 100 \angle (-60^\circ) \\ &= 60 - j60\sqrt{3} \text{ V} = 120 \angle (-60^\circ) \text{ V} \end{aligned}$$

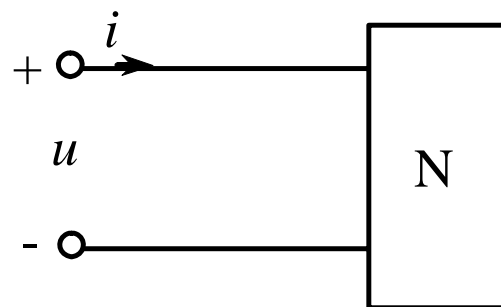
4. 图示正弦交流电路中，已知：  $u=110\cos(\omega t+15^\circ)\text{V}$ ， $i=10\cos(\omega t-15^\circ)\text{A}$ ，求无源网络N吸收的平均功率P、无功功率Q及视在功率S。

解 平均功率P为

$$P = \frac{110}{\sqrt{2}} \times \frac{10}{\sqrt{2}} \cos 30^\circ = 275\sqrt{3} \text{ W}$$

$$Q = \frac{110}{\sqrt{2}} \times \frac{10}{\sqrt{2}} \sin 30^\circ = 275 \text{ Var}$$

$$S = \frac{110}{\sqrt{2}} \times \frac{10}{\sqrt{2}} = 550 \text{ VA}$$





5. 电路如图所示, 已知  $\dot{U}_C = 200\angle 0^\circ \text{V}$  ,  $I_C=20\text{A}$ ,  $X_C=10\Omega$ ,  $Z=5+j5\Omega$ , 求  $\dot{U}_s$  。

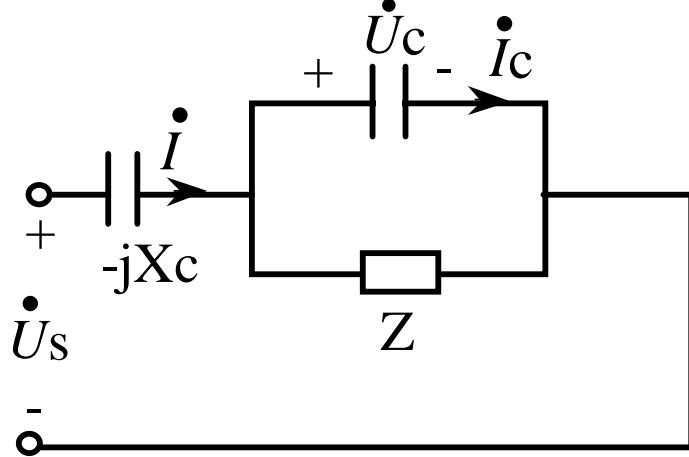
解  $\dot{U}_C = 200\angle 0^\circ \text{V}$

$$\dot{I}_C = 20\angle 90^\circ \text{A}$$

$$\dot{I}_Z = \dot{U}_C / Z = 20\sqrt{2}\angle -45^\circ \text{A}$$

$$\dot{I} = \dot{I}_C + \dot{I}_Z = 20\angle 90^\circ + 20\sqrt{2}\angle -45^\circ = 20 \text{A}$$

$$\dot{U}_s = -jX_C \dot{I} + \dot{U}_C = -j200 + 200 = 200\sqrt{2}\angle -45^\circ \text{V}$$



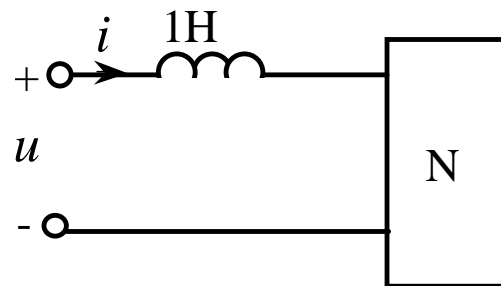
6. 图示正弦交流电路中，已知： $u=100\cos(10t-60^\circ)\text{V}$ ， $i=20\sin(10t-60^\circ)\text{A}$ ，问无源网络N由何元件组成？

解

$$i=20\sin(10t-60^\circ)=20\cos(10t-60^\circ-90^\circ)=20\cos(10t-150^\circ)\text{A}$$

$$Z = \frac{\dot{U}}{\dot{I}} = j5 \Omega$$

1H电感串入电路，感抗由j10  $\Omega$  减小为j5  $\Omega$ ，所以，N为电容



即

$$j10-jX_c=j5$$

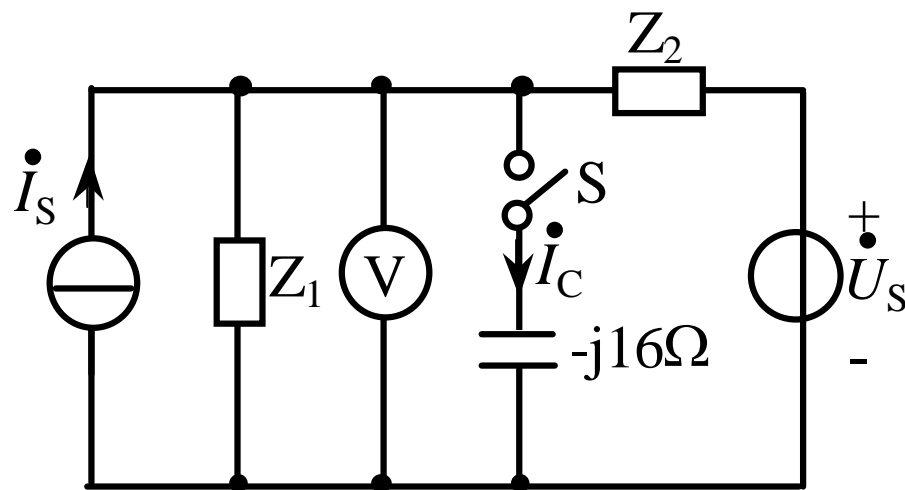
则

$$\frac{1}{\omega C} = 5$$

$$C=0.02\text{F}$$

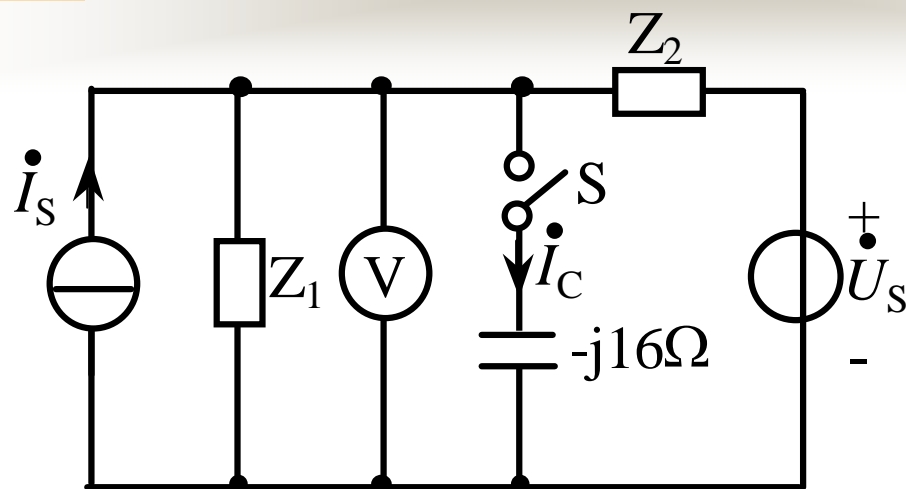


7. 电路如图所示, 独立电源为同频正弦量, 当S打开时, 电压表的读数为25V。电路中阻抗为 $Z_1=(6+j12)\Omega$ ,  $Z_2=2Z_1$ 。求S闭合后流过电容的电流。



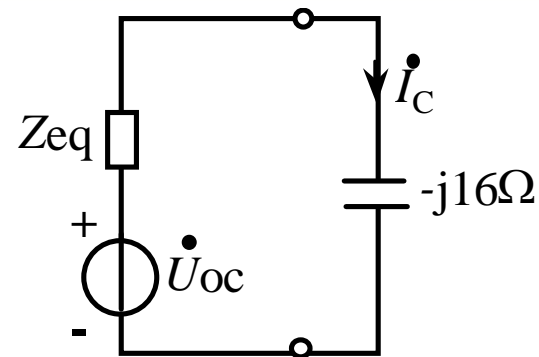
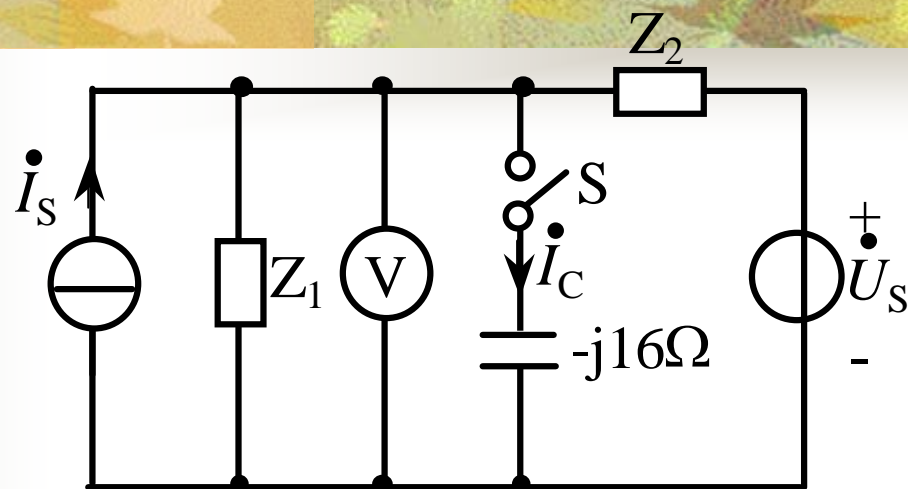
解 当S打开时, 电压表的读数实际上是开路电压 $U_{oc}$ , 设

$$\dot{U}_{oc} = 25 \angle 0^\circ \text{ V}$$



将电流源断开，电压源短路，得等效阻抗为

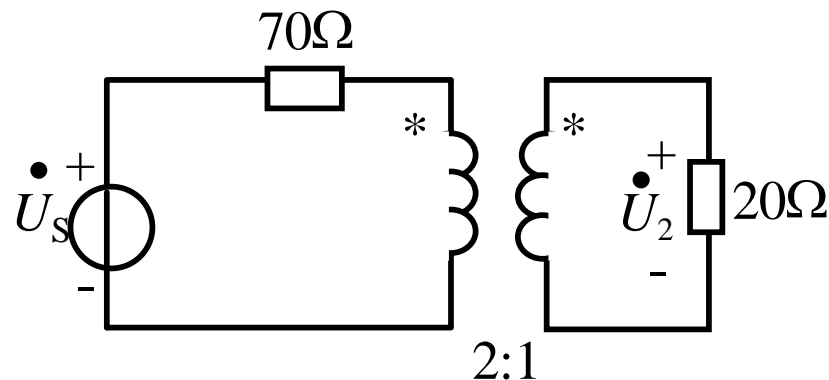
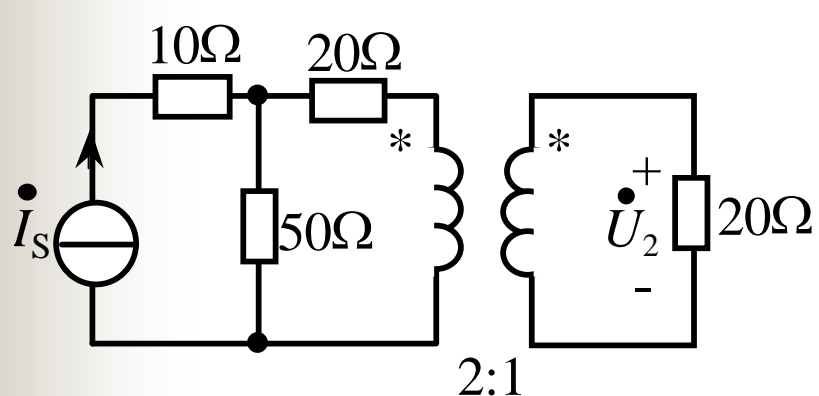
$$\begin{aligned}
 Z_{eq} &= \frac{Z_1 Z_2}{Z_1 + Z_2} = \frac{2}{3} Z_1 \\
 &= \frac{2}{3} (6 + j12) = 4 + j8 \, \Omega
 \end{aligned}$$



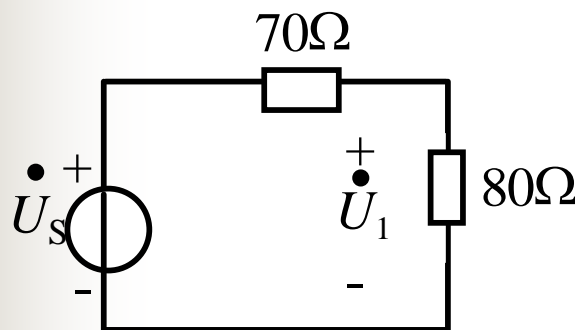
开关S闭合后得等效电路如图所示。由图可知流过电容得电流为

$$\begin{aligned} \dot{I}_c &= \frac{\dot{U}_{oc}}{Z_{eq} - j16} = \frac{25 \angle 0^\circ}{4 - j8} \\ &= 2.8 \angle 75.96^\circ \text{ A} \end{aligned}$$

8. 如图所示电路中, 已知  $\dot{I}_s = 6\angle 0^\circ \text{ A}$ , 求  $\dot{U}_2$ 。



**解** 电路等效为



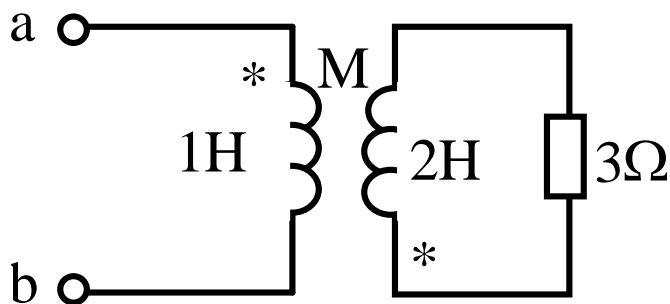
$$\dot{U}_s = 300\angle 0^\circ \text{ V}$$

$$\dot{U}_1 = \frac{80}{70 + 80} \times 300\angle 0^\circ = 160\angle 0^\circ \text{ V}$$

$$\dot{U}_2 = \frac{\dot{U}_1}{2} = 80\angle 0^\circ \text{ V}$$

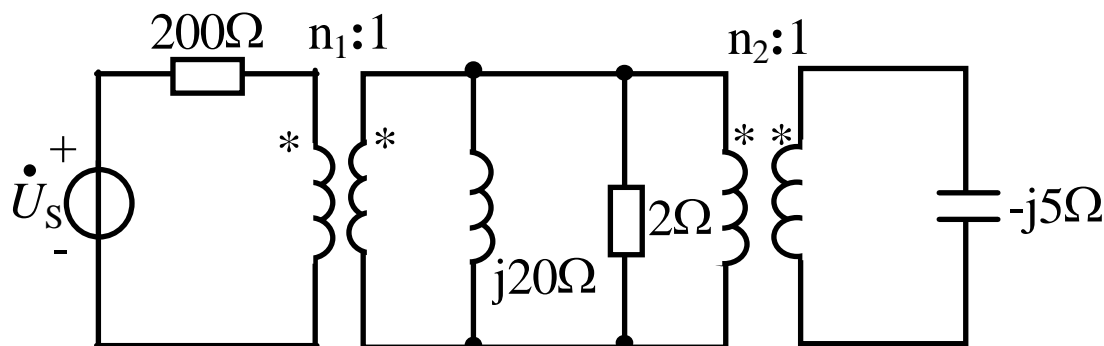
9. 如图所示电路, 已知电源角频率 $\omega=2\text{rad/s}$ ,  $M=1\text{H}$ , 求  $Z_{ab}$ 。

解



$$\begin{aligned} Z_{ab} &= j2 \times 1 + \frac{(2 \times 1)^2}{3 + j2 \times 2} \\ &= j2 + \frac{4}{3 + j4} = j2 + 0.8 \angle -53.1^\circ \\ &= 0.48 + j1.36 = 1.44 \angle 70.56^\circ \Omega \end{aligned}$$

10. 如图所示电路, 已知 $U_S=200\text{V}$ , 问 $n_1, n_2$ 取什么值时,  $2\Omega$ 电阻获最大功率, 最大功率为多少?



解

$$n_2^2 \times 5 = 20 \quad n_2 = 2$$

$$n_1^2 \times 2 = 200 \quad n_1 = 10$$

$$P_{\max} = \frac{U_S^2}{4 \times 200} = 50\text{W}$$





## 答疑时间安排

6月22—23日      上午8:30—11:30  
下午14:30—17:30

6月24 :上午8:30—11:00

答疑地点: **B座405**