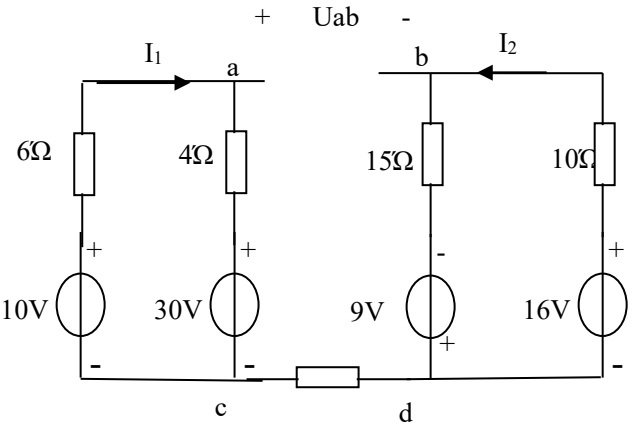
1-9 求图 1-65 中的电压 Uab

$$I_1 = \frac{10-30}{6+4} = -2A$$

$$I_2 = \frac{16+9}{15+10} = 1A$$

$$U_{cd} = 0$$

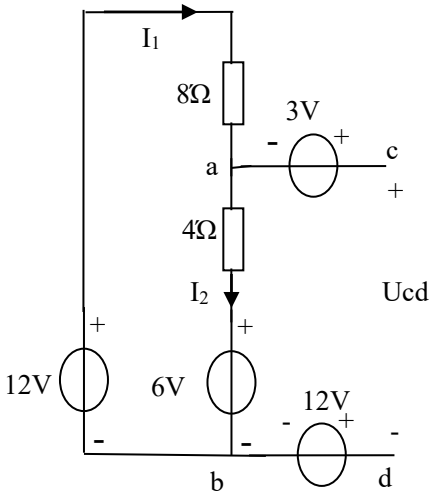
$$U_{ab} = 4I_1 + 30 - U_{cd} + 9 - 15I_2 = 16V$$



1-10 求图 1-66 中的电压 Ucd

$$I_1 = I_2 = \frac{12-6}{8+4} = 0.5A$$

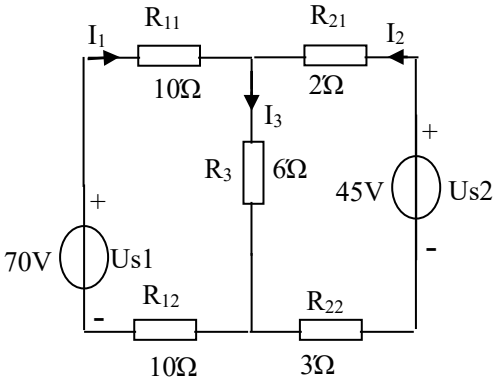
$$U_{cd} = 3 + 4I_2 + 6 - 12 = -1V$$



1-12 用支路电流法求图 1-68 中的各支路的电流

$$\begin{cases} I_1 + I_2 = I_3 \\ (R_{11} + R_{12})I_1 + R_3 I_3 = U_{S1} \\ (R_{21} + R_{22})I_1 + R_3 I_3 = U_{S2} \end{cases}$$

解得 $I_1 = 2A, I_2 = 5A, I_3 = 3A$

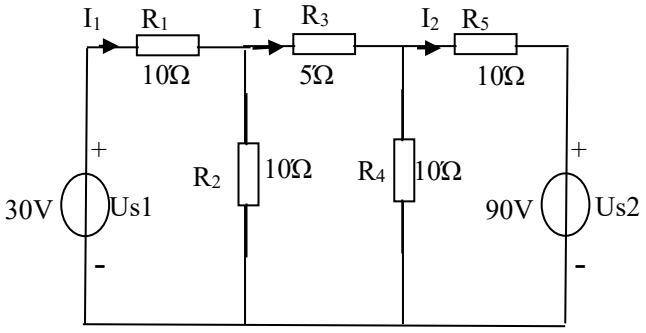


1-15 用叠加定理求图 1-70 中的电流 I

Us1 单独工作时

$$I_1^{'} = \frac{U_{S1}}{R_1 + R_2 //(R_3 + R_4 // R_5)} = 2A$$

$$I^{'} = \frac{R_2}{R_2 + (R_3 + R_4 // R_5)} \times I_1^{'} = 1A$$

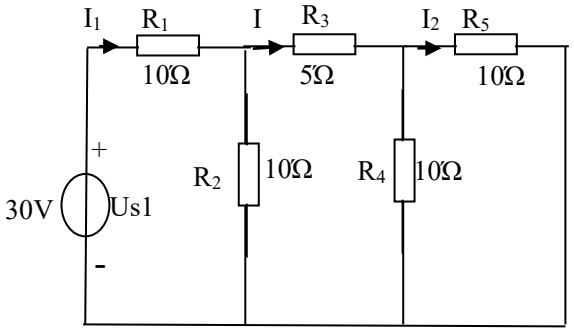


Us2 单独工作时

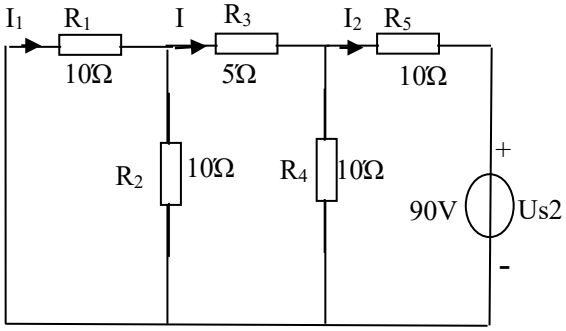
$$I_2^{''} = -\frac{U_{S2}}{R_5 + R_4 //(R_3 + R_2 // R_1)} = -6A$$

$$I'' = \frac{R_4}{R_4 + (R_3 + R_2 // R_1)} \times I_1^{'} = -3A$$

$$I = I^{'} + I^{''''} = -2A,$$

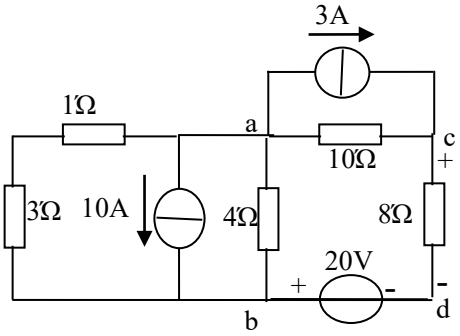


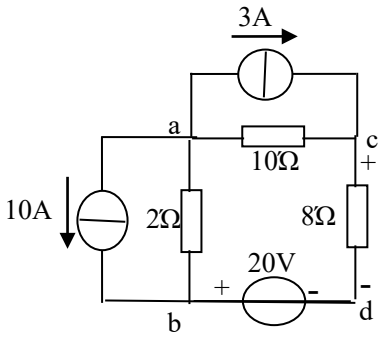
Us1 单独工作



Us2 单独工作

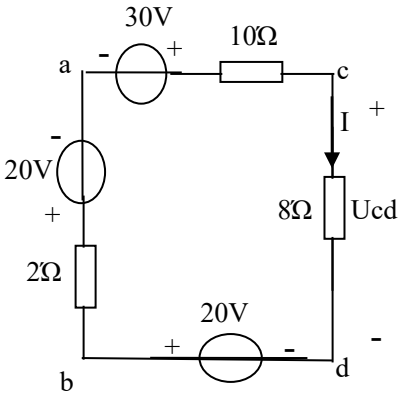
1-17 用电源等效变换的方法求图 1-72 中的电压 Ucd



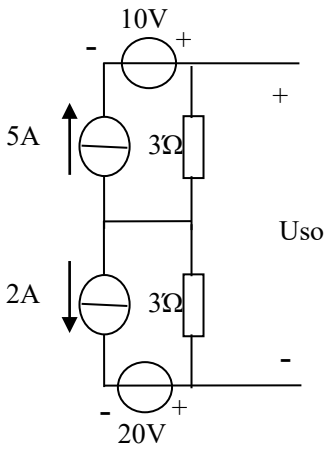


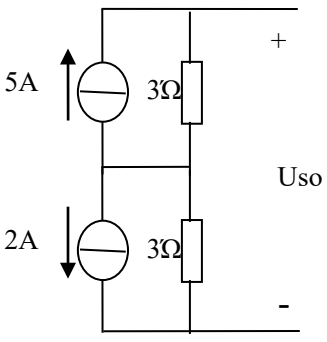
$$I=\frac{30-20+20}{10+2+8}=1.5A$$

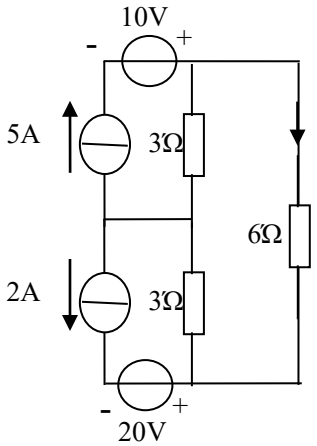
$$U_{cd}=I\times 8=12V$$



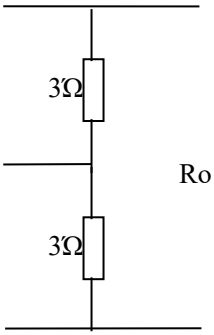
1-18 用戴维宁定理求图 1-73 中的电流 I

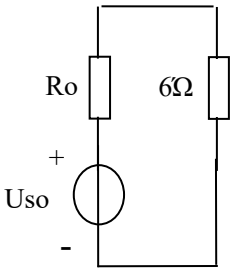






$$U_{so}=5\times 3-2\times 3=9V$$

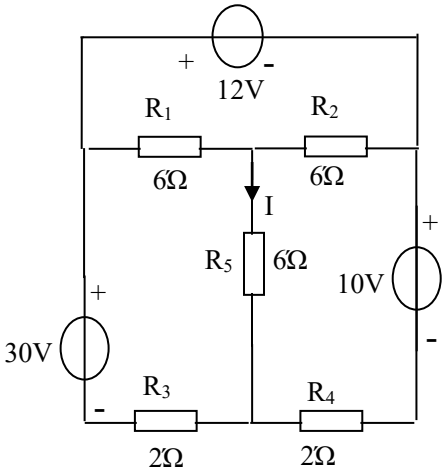


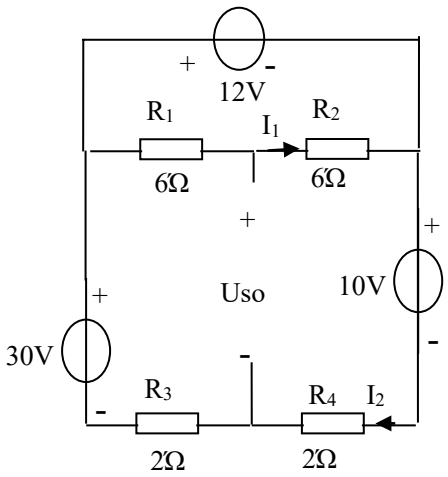


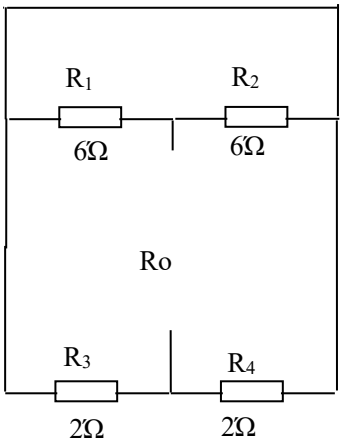
$$R_0 = 3 + 3 = 6\Omega$$

$$I = \frac{U_{so}}{R_0 + 6} = 0.75A$$

1-19 用戴维宁定理求图 1-74 中的电流 I







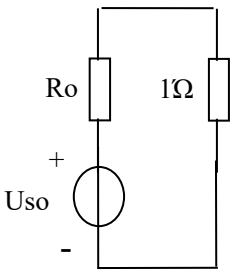
$$I_1 = \frac{12}{R_1 + R_2} = 1A$$

$$I_2 = \frac{30 - 12 - 10}{R_3 + R_4} = 2A$$

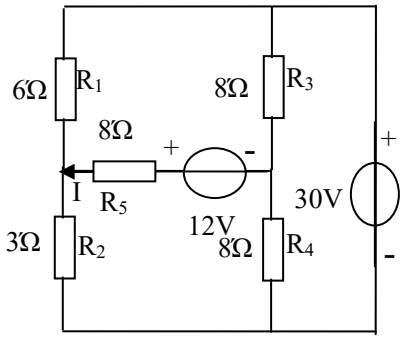
$$U_{so} = I_1 R_2 + 10 + I_2 R_4 = 20V$$

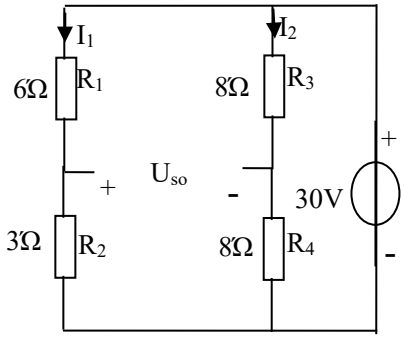
$$R_0 = R_1 // R_2 + R_3 // R_4 = 4\Omega$$

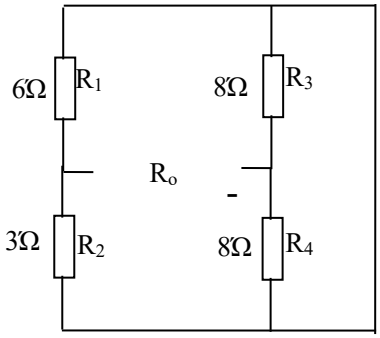
$$I = \frac{U_{so}}{R_0 + 6} = 2A$$



1-36 求图 1-87 中的电流 I



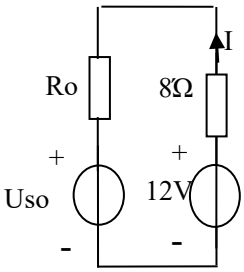




$$I_1 = \frac{30}{R_1 + R_2} = 3.33A$$

$$I_2 = \frac{30}{R_3 + R_4} = 1.875A$$

$$U_{so} = I_1 R_2 - I_2 R_4 = -5V$$



$$R_0 = R_1 // R_2 + R_3 // R_4 = 6\Omega$$

$$I = \frac{-U_{so} + 12}{R_0 + 8} = \frac{17}{14}A$$

2-3 已知$u_1 = 141\sin(wt - 30°)V$，$u_2 = 282\sin(wt + 45°)V$。(1）写出相量式$\dot{U}_1$和$\dot{U}_2$;(2) 求 u1 和 u2 的相位差。

$\dot{U}_1 = 100\angle -30°V$

$\dot{U}_2 = 200\angle 45°V$

$\varphi = -30° - 45° = -75°$

2-4 已知$\dot{I}_1 = 3 + j4A$，$\dot{I}_2 = 3 - j4A$，角频率都是 w，写出 i1 和 i2 的函数表达式。

$\dot{I}_1 = 3 + j4 = 5\angle 53°A$

$\dot{I}_2 = 3 - j4 = 5\angle -53°A$

$i_1 = 5\sqrt{2}\sin(wt + 53°)A$

$i_2 = 5\sqrt{2}\sin(wt - 53°)A$

2-6 已知$i_1 = 10\sin(wt + 30°)A, i_2 = 10\sin(wt - 60°)A$,用相量法求它们的和及差。

$\dot{I}_1 = 5\sqrt{2}\angle 30°A$

$\dot{I}_2 = 5\sqrt{2}\angle -60°A$

$\dot{I}_1 + \dot{I}_2 = 10\angle -15°A$

$\dot{I}_1 - \dot{I}_2 = 10\angle 75°A$

$i_1 + i_2 = 10\sqrt{2}\sin(wt - 15°)A$

$i_1 - i_2 = 10\sqrt{2}\sin(wt + 75°)A$

2-8 当线圈接在 60V 直流电源上时，电流为 10A; 接在 50Hz,60V 交流电源上时，电流为 6A。求线圈电阻 R、感抗 X_L 和电感 L。

$R = \frac{60}{10} = 6\Omega$

$w = 2\pi f = 314rad/s$

$|Z| = \frac{60}{6} = 10\Omega$

$X_L = \sqrt{10^2 - 6^2} = 8\Omega$

$L = \frac{X_L}{w} = 25.5mH$

2-12 在图 2-39 中，已知 R_1=2Ω,X_C=80Ω,$\dot{U} = 100\angle 60°V, \dot{I} = 10\angle 0°A$。(1）求 R_2 和 X_L

(2）求$\dot{U}_1$、$\dot{U}_C$、$\dot{U}_L$、$\dot{U}_2$ (3)画出电流和各电压的相量图。

$$Z_1 = R_1 - jX_C = 2 - j80\Omega$$

$$Z = \frac{\dot{U}}{\dot{I}} = 10\angle 60° = 5 + j5\sqrt{3}\Omega$$

$$Z_2 = Z - Z_1 = 3 + 88.66\Omega$$

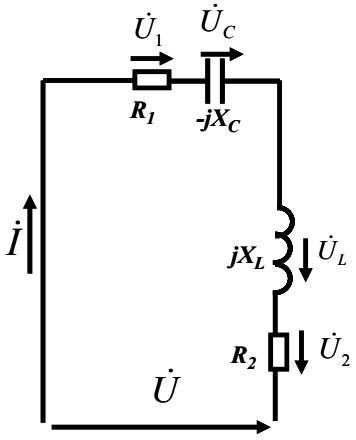
$$R_2 = 3\Omega, X_L = 88.66\Omega$$

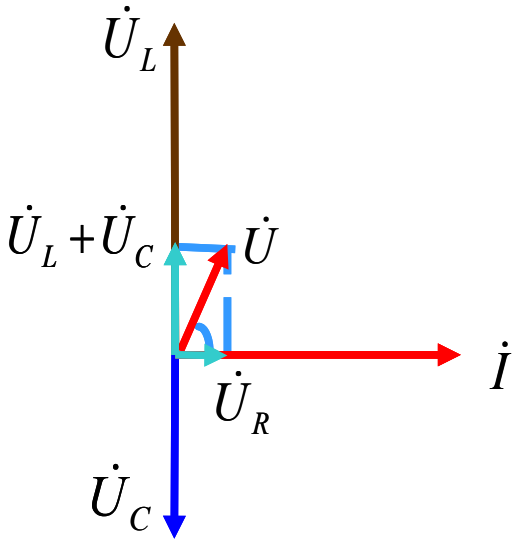
$$\dot{U}_1 = \dot{I}R_1 = 20\angle 0°V$$

$$\dot{U}_2 = \dot{I}R_2 = 30\angle 0°V$$

$$\dot{U}_C = \dot{I}X_C = 800\angle -90°V$$

$$\dot{U}_L = \dot{I}X_L = 866\angle 90°V$$





2-13 在图 2-40 中，已知$\dot{U} = 220\angle 0°V$，R_1=3Ω,X_L=4Ω, R_2=8Ω,X_C=6Ω,求$\dot{I}$、$\dot{I}_1$和$\dot{I}_2$

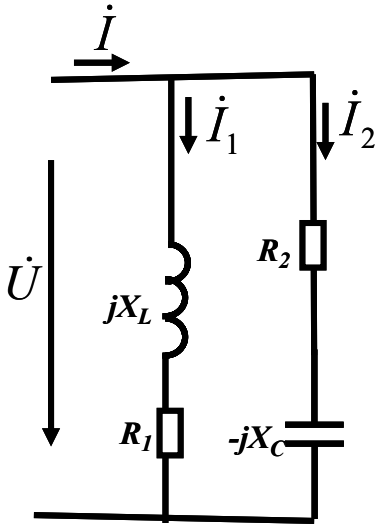
$$Z_1 = R_1 + jX_L = 3 + j4\Omega$$

$$Z_2 = R_2 - jX_C = 8 - j6\Omega$$

$$\dot{I}_1 = \frac{\dot{U}}{Z_1} = 44\angle -53°A$$

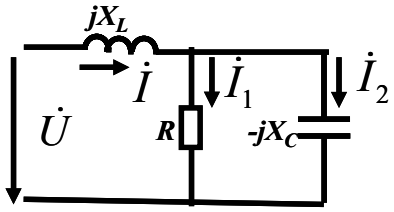
$$\dot{I}_2 = \frac{\dot{U}}{Z_2} = 22\angle 37°A$$

$$\dot{I} = \dot{I}_1 + \dot{I}_2 = 49.2\angle -26.6°A$$



2-17 在图 2-43 中，已知 $I_1 = I_2 = 10\sqrt{2}A$，U=100V,$\dot{U}$与$\dot{I}$ 同相。求 I、R、X_C 及 X_L

设电阻 R 两端的电压 UR 的相位为 0 度。



$\dot{I}_1 = 10\sqrt{2}\angle 0°A$

$\dot{I}_2 = 10\sqrt{2}\angle 90°A$

$\dot{I} = \dot{I}_1 + \dot{I}_2 = 20\angle 45°A$

$\dot{U}_L = \dot{I}(jX_L) = 20X_L\angle 135°V$

$\dot{U}_R = \dot{I}_1 R = 10\sqrt{2}R\angle 0°V$

$\dot{U} = \dot{U}_R + \dot{U}_L = 10\sqrt{2}R\angle 0° + 20X_L\angle 135°$

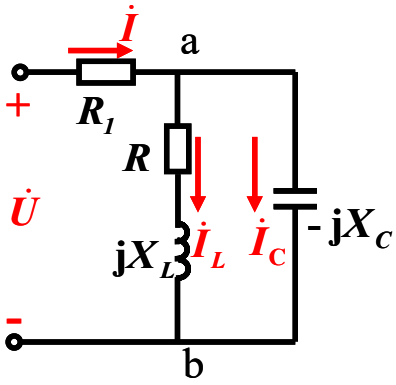
$= 10\sqrt{2}R - 10\sqrt{2}X_L + j10\sqrt{2}X_L = 100\angle 45°V$

$10\sqrt{2}R - 10\sqrt{2}X_L = 50\sqrt{2}$

$10\sqrt{2}X_L = 50\sqrt{2}$

$X_L = 5\Omega, R = X_C = 10\Omega,, I = 20A$

2-18 在图 2-44 中，已知 U=100V, R_1=2Ω, R=X_L，$I_L = 10\sqrt{2}A, I_C = 10A$。以 U_{ab} 为参考相量，画出相量图，求 R、X_C 及 X_L



$\dot{I}_L = 10\sqrt{2}\angle -45°A$

$\dot{I}_C = 10\angle 90°A$

$\dot{I} = \dot{I}_1 + \dot{I}_2 = 10\angle 0°A$

$\dot{U}_R = \dot{I}R_1 = 20\angle 0°V$

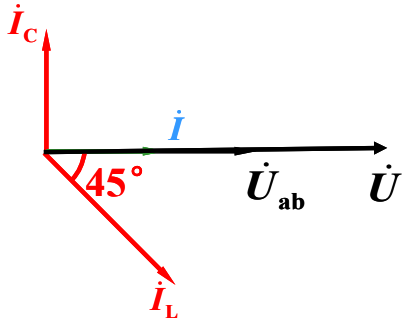
$\dot{U} = \dot{U}_R + \dot{U}_{ab} = 100\angle 0°V$

$\dot{U}_{ab} = 80\angle 0°V$

$X_C = \dfrac{U_{ab}}{I_C} = 8\Omega$

$R + jX_L = \dfrac{\dot{U}_{ab}}{\dot{I}_L} = 4\sqrt{2}\angle 45° = 4 + j4\Omega$

$X_C = 8\Omega, R = X_L = 4\Omega$

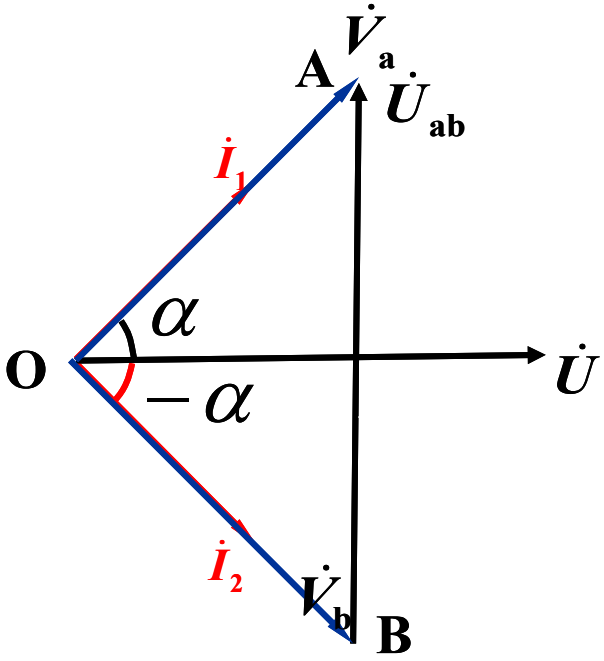


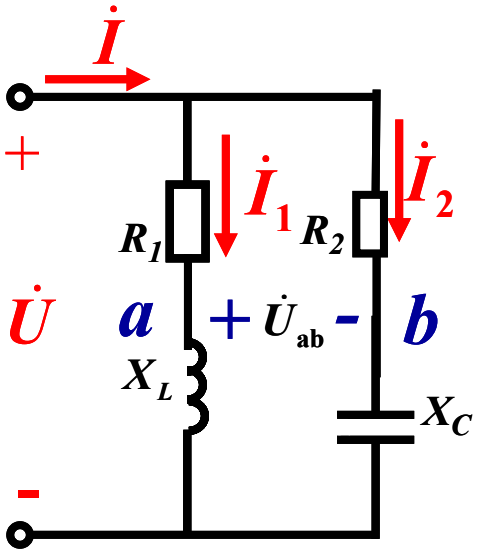
2-28 在图 2-51 中，已知 $R_1 = R_2$，$X_L = X_C$。利用相量图证明$\dot{U}_{ab}$与$\dot{U}$间的相位差为90°

设$\dot{U}$为0度。则$\dot{I}_1$为α，$\dot{I}_2$为$-\alpha$，

$\dot{V}_a$超前$\dot{I}_1$90°，$\dot{V}_b$滞后$\dot{I}_2$90°，$V_a = V_b$

ΔAOB为等腰三角形，OU为角平分线$\therefore \dot{U}_{ab} \perp \dot{U}$





2-32 已知电感性负载的有功功率为 300kW，功率因数为 0.65，若要将功率因数提高到 0.9，求电容器的无功功率。

$$S_1 = \frac{P}{\cos\varphi_1} = 461.5kW$$

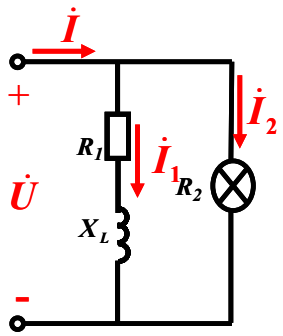
$$S_2 = \frac{P}{\cos\varphi_2} = 333.3kW$$

$$\cos\varphi_1 = 0.65 \varphi_1 = 49.46° \sin\varphi_1 = 0.76 Q_1 = S_1 \sin\varphi_1 = 350.77\,\text{var}$$

$$\cos\varphi_2 = 0.9 \varphi_2 = 25.84° \sin\varphi_2 = 0.44 Q_2 = S_2 \sin\varphi_2 = 145.27\,\text{var}$$

$$Q_C = Q_2 - Q_1 = -205.5\,\text{var}$$

2-19 图 2-45 为日光灯和白炽灯并联的电路，图中 R_1 为灯管电阻，X_L 为镇流器感抗，R2 为白炽灯电阻。已知 U=220V，镇流器电阻不计，灯管功率为 40w，功率因数为 0.5；白炽灯功率为 60w，求 I_1、I_2、I 及总的功率因数



$$R_2 = \frac{220^2}{60} = 807\Omega$$

$$设\dot{U} = 220\angle 0°V$$

$$\varphi = \arccos 0.5 = 60°$$

$$\dot{I}_1 = \frac{P_1}{U\cos\varphi}\angle -60° = 0.364\angle -60° A$$

$$\dot{I}_2 = \frac{\dot{U}}{R_2} = 0.273\angle 0° A$$

$$\dot{I} = \dot{I}_1 + \dot{I}_2 = 0.55\angle -34.7° A$$

$$\lambda = \cos(-34.7) = 0.82$$

$$I_1 = 0.364A, I_2 = 0.273A, I = 0.55A$$

3-2 在线电压为 380V 的三相四线制电源上接有额定电压为 220V、功率为 100w 的白炽灯。设 L1 相和 L2 相各接 20 盏，L3 相接 40 盏。求相电流和中线电流。

设$\dot{U}_1 = 220\angle 0°V$

$$R = \frac{220^2}{100} = 484\Omega R_1 = R_2 = \frac{R}{20} = 24.2\Omega R_3 = \frac{R}{40} = 12.1\Omega$$

$$\dot{I}_1 = \frac{\dot{U}_1}{R_1} = 9.1\angle 0°A$$

$$\dot{I}_2 = \frac{\dot{U}_2}{R_2} = 9.1\angle -120°A$$

$$\dot{I}_3 = \frac{\dot{U}_3}{R_3} = 18.2\angle 120°A$$

$$\dot{I}_N = \dot{I}_1 + \dot{I}_2 + \dot{I}_3 = 9.1\angle 120°A$$

$$I_1 = 9.1A, I_2 = 9.1A, I_3 = 18.2A, I_N = 9.1A$$

3-3 上题中，若 L1 相因熔丝烧断而白炽灯全部熄灭，中心线又因故断开，求 L2 和 L3 相白炽灯上的电压。

$L2$和$L3$上白炽灯的总电压为$U_{23} = 380V$

$$\text{所以}U_{L2} = \frac{U_{23}}{R_2 + R_3}R_2 = 253.3V U_{L3} = \frac{U_{23}}{R_2 + R_3}R_3 = 126.7V$$

3-4 在线电压为 380V 的三相四线制电源上，星型联接负载的 L1 相接电阻, L2 相接电感, L3 相接电容。各相的阻抗值都是 10Ω。(1)画出电路图(2)以$\dot{U}_1$为参考相量，求$\dot{I}_1$、$\dot{I}_2$、$\dot{I}_3$和$\dot{I}_N$

（3）画出电压和电流的相量图

$\dot{U}_1 = 220\angle 0°V$

$\dot{U}_2 = 220\angle -120°V$

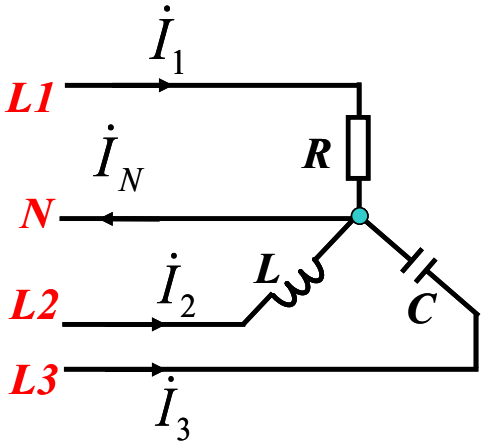
$\dot{U}_3 = 220\angle 120°V$

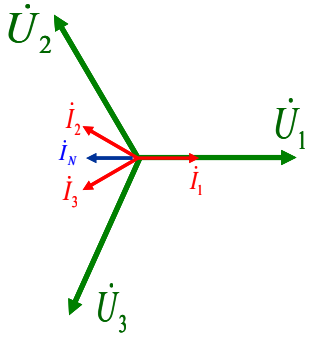
$$\dot{I}_1 = \frac{\dot{U}_1}{R} = 22\angle 0°A$$

$$\dot{I}_2 = \frac{\dot{U}_2}{jX_L} = 22\angle 150°A$$

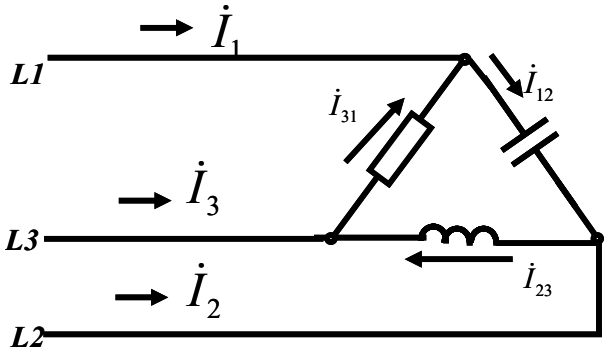
$$\dot{I}_3 = \frac{\dot{U}_3}{-jX_C} = 22\angle -150°A$$

$$\dot{I}_N = \dot{I}_1 + \dot{I}_2 + \dot{I}_3 = 16.1\angle 180°A$$



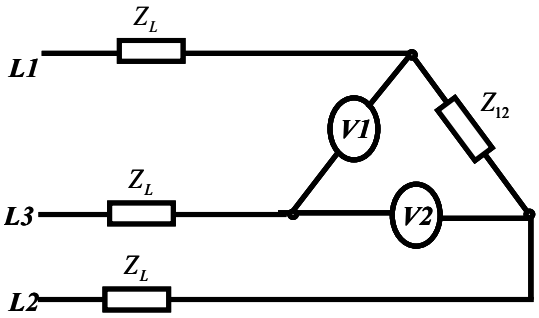


3-6 在图 3-26 中，已知每相阻抗都是 38Ω，线电压为 380V。以线电压 U_{12} 为参考相量，求各相电流和线电流。



$$\dot{U}_{12} = 380\angle 0°V$$
$$\dot{U}_{23} = 380\angle -120°V$$
$$\dot{U}_{31} = 380\angle 120°V$$
$$\dot{I}_{12} = \frac{\dot{U}_{12}}{-jX_C} = 10\angle 90°A$$
$$\dot{I}_{23} = \frac{\dot{U}_{23}}{jX_L} = 10\angle 150°A$$
$$\dot{I}_{31} = \frac{\dot{U}_{31}}{R} = 10\angle 120°A$$
$$\dot{I}_1 = \dot{I}_{12} - \dot{I}_{23} = 5.2\angle 15°A$$
$$\dot{I}_2 = \dot{I}_{23} - \dot{I}_{12} = 10\angle -150°A$$
$$\dot{I}_3 = \dot{I}_{31} - \dot{I}_{23} = 5.2\angle 45°A$$

3-7 图 3-27 中，已知电源线电压为 380V，导线阻抗 Z_L=20+j40Ω,负载阻抗 Z_{12}=120+j40Ω，电压表中均无电流通过，求电压表 V1 和 V2 的读数。



$$\dot{U}_{12} = 380\angle 0°V$$
$$\dot{U}_{23} = 380\angle -120°V$$
$$\dot{U}_{31} = 380\angle 120°V$$
$$\dot{I}_{12} = \frac{\dot{U}_{12}}{Z_{12} + 2Z_L} = 1.9\angle -37°A$$
$$\dot{U}_{V1} = \dot{U}_{31} + \dot{I}_{12}Z_L = -114 + j367$$
$$\dot{U}_{V2} = \dot{U}_{23} + \dot{I}_{12}Z_L = -291 - j114$$
$$U_{V1} = 384V, U_{V2} = 313V$$

3-10 已知三角形联接三相对称负载的总几率为 5.5kW，线电流为 19.5A，电源线电压为 380V。求每相的电阻和感抗。

$$\cos\varphi = \frac{P}{\sqrt{3}U_l I_l} = 0.43$$

$$|Z| = \frac{U_l}{I_l/\sqrt{3}} = 33.7\Omega$$

$$R = |Z|\cos\varphi = 14.5\Omega$$

$$X_L = |Z|\sin\varphi = 30.6\Omega$$

3-11 总功率为 10k W,三角形联接的三相对称电阻炉与输入总功率为 12kW，功率因数为 0.707 的三相异步电动机接在线电压为 380V 的三相电源上。求电阻炉、电动机以及总的线电流。

$$设\dot{U}_{12} = 380\angle 0°V$$

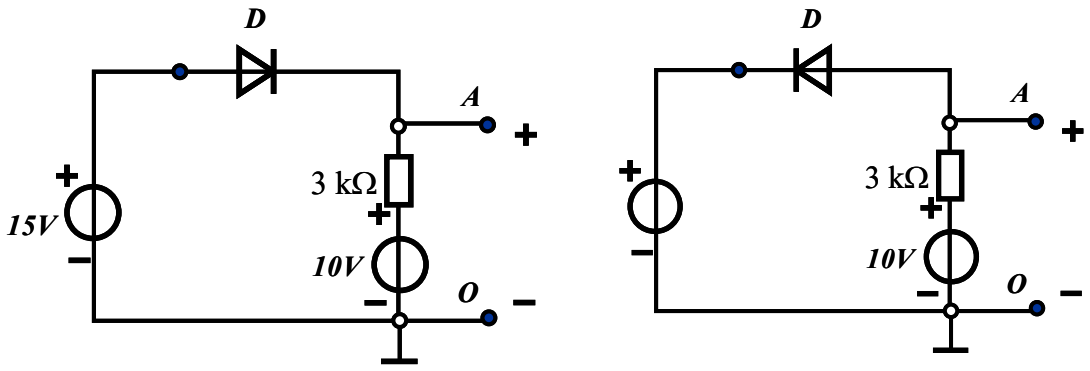
$$\dot{I}_{l1电阻炉} = \frac{P_{电阻炉}}{\sqrt{3}U_l}\angle -30° = 15.2\angle -30°A$$

$$\dot{I}_{l1电动机} = \frac{P_{电动机}}{\sqrt{3}U_l\cos\varphi}\angle -\arccos 0.707 - 30° = 25.8\angle -75°A$$

$$\dot{I}_{l1总电流} = \dot{I}_{l1电阻炉} + \dot{I}_{l1电动机} = 38\angle -58.5°A$$

$$I_{l电阻炉} = 15.2A, I_{l电动机} = 25.8A, I_{l总电流} = 38A$$

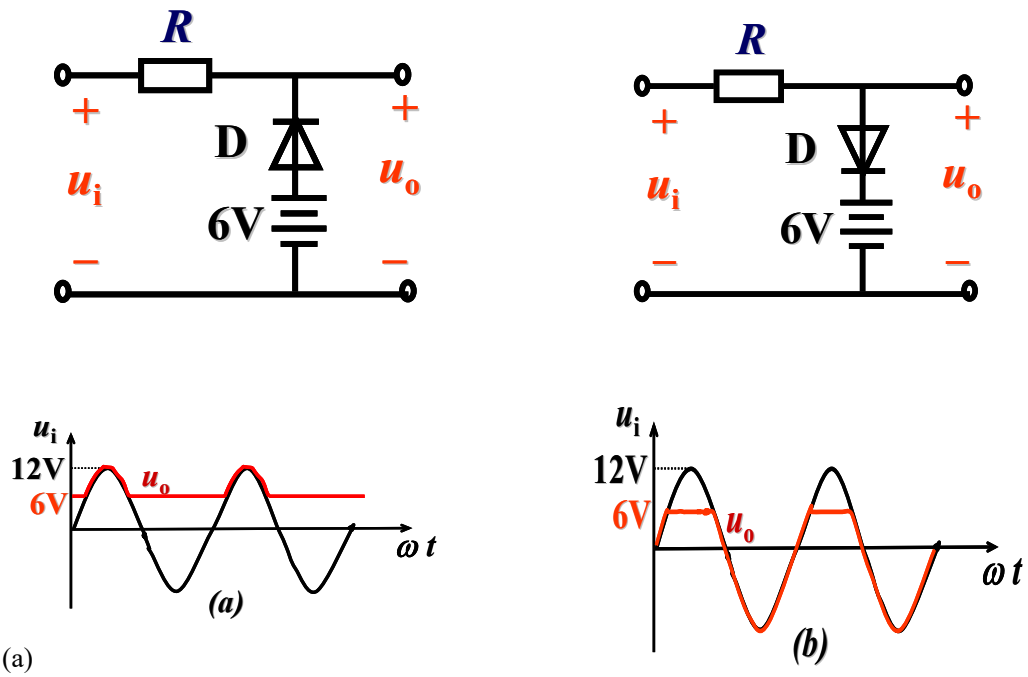
5-1 理想二极管电路如图 7-32 所示，求 U_{AO}



（a）D 导通 U_{AO}=15V

（b）D 截止 U_{AO}=10V

5-2 理想二极管电路如图 7-33 所示，已知输入电压 u_i=12sinwtV，试画出输出电压 u_o 的波形



(a)

$u_i < 6V$，二极管导通，可看作短路　　$u_o = 6V$

$u_i > 6V$，二极管截止，可看作开路　　$u_o = u_i$

(b)

$u_i > 6V$，二极管导通，可看作短路　　$u_o = 6V$

$u_i < 6V$，二极管截止，可看作开路　　$u_o = u_i$

5-3 有一桥式整流电路，变压器二次电压 U_2=100V，负载电阻 R_L=100Ω，二极管是理想的，试计算：（1）输出电压 U_0；（2）负载电流 I_0；（3）二极管电流 I_D；（4）二极管所承受的最

大反向电压 U_{RM}。

$(1)U_0 = 0.9U_2 = 90V$

$(2)I_0 = \frac{U_0}{R_L} = 0.9A$

$(3)I_0 = \frac{I_0}{2} = 0.45A$

$(4)U_0 = \sqrt{2}U_2 = 141V$

5-4 图 7-34 所示为桥式整流，电容滤波电路，变压器二次电压 U_2=10V，二极管是理想的，试计算：（1）输出电压 U_0；（2）电容开路时的 U_0；（3）负载开路时的 U_0；（4）一个二极管开路时的 U_0；（5）电容和一个二极管同时开路时的 U_0；（6）二极管所承受的最大反向电压 U_{RM}。

$(1)U_0 = 1.2U_2 = 12V$

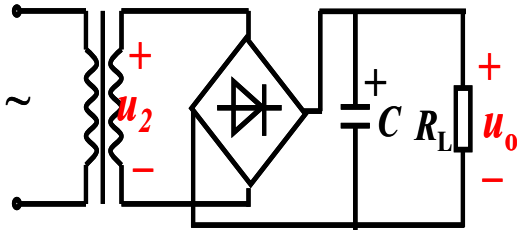
$(2)U_0 = 0.9U_2 = 9V$

$(3)U_0 = \sqrt{2}U_2 = 14V$

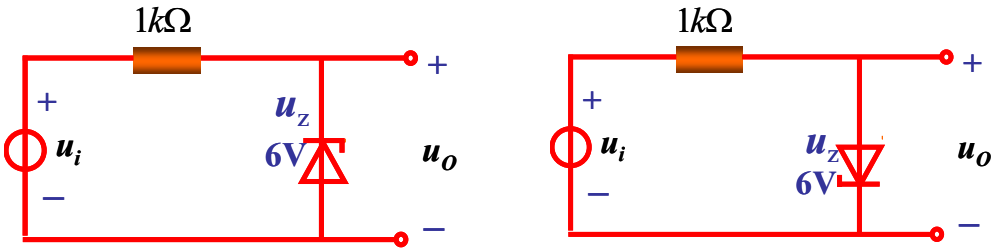
$(4)U_0 = 1.0U_2 = 10V$

$(5)U_0 = 0.45U_2 = 4.5V$

$(6)U_0 = \sqrt{2}U_2 = 14V$



5-5 稳压管电路如图 7-35 所示，已知输入电压 u_i=12sinwtV，稳压管的 UZ=6V，其正向压降不计。试画出输出电压 u_o 的波形。



(a)

u_i <0V，稳压管正向导通，可看作短路，u_o = 0V

0<u_i < 6V，稳压管反向截止，可看作开路　　$u_o = u_i$

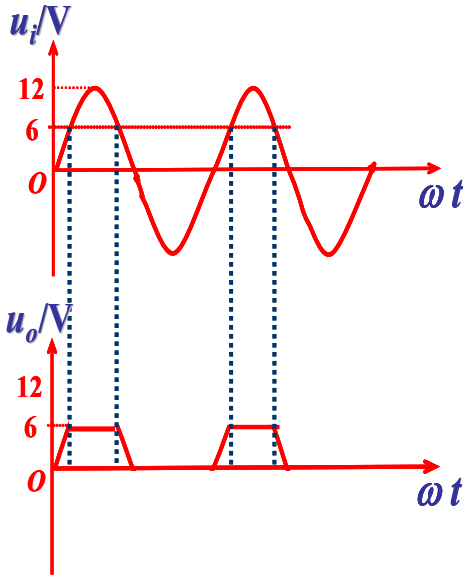
u_i > 6V，稳压管击穿，　　u_o = 6V

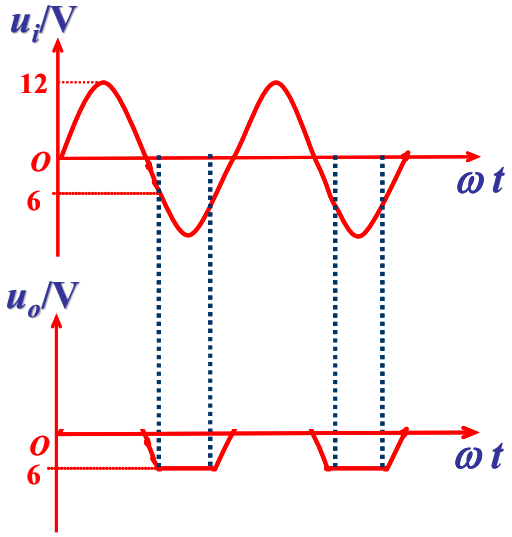
(b)

u_i> 0 V，稳压管正向导通，可看作短路，u_o = 0V

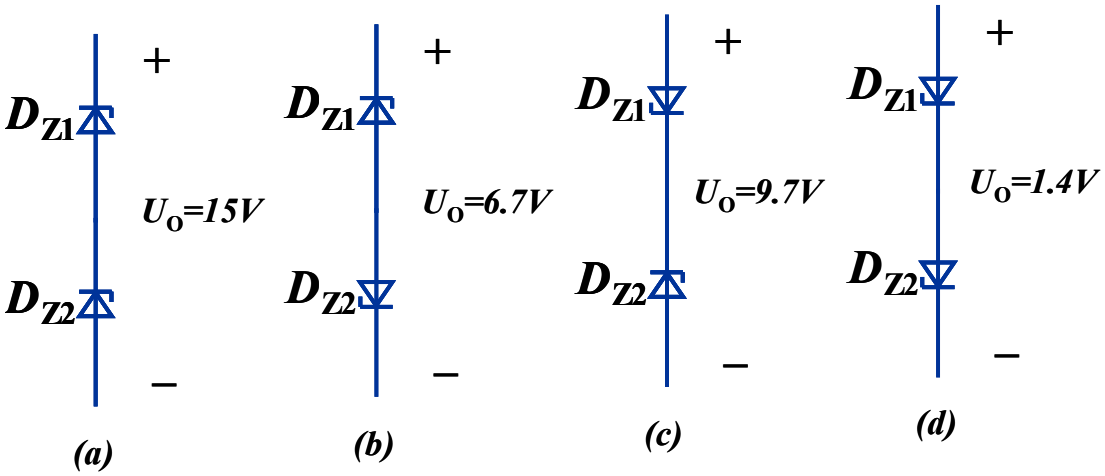
-6<u_i <0 V，稳压管反向截止，可看作开路　　$u_o = u_i$

u_i <-6V，稳压管击穿，　　u_o = -6V





5-6 两只硅稳压管的稳压值分别为 U_{Z1}=6V,U_{Z2}=9V,其正向压降为 0.7V。把它们串联相接可得到几种输出电压值，各为多少？（作图表示）



6-4 在图 8-50 所示电路中，已知 V_{CC}=12V，R_C=2kΩ，R_B=150kΩ，双击晶体管的 $\overline{\beta}=50$。求 I_B、I_C、U_{CE} 的值。

$$(I_C+I_B)R_C+I_BR_B+U_{BE}=V_{CC}$$

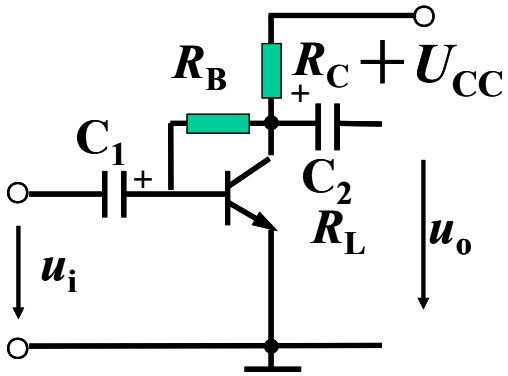
$$I_C=\overline{\beta}I_B$$

$$U_{CE}\approx V_{CC}-I_CR_C$$

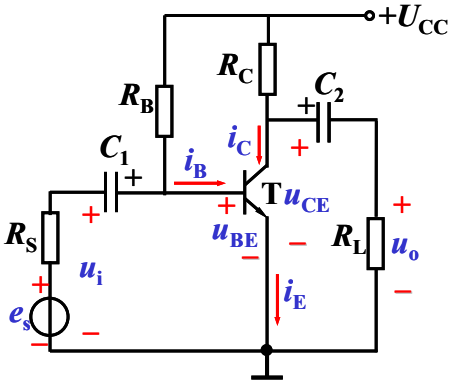
$$I_B=\frac{V_{CC}-U_{BE}}{R_B+(1+\overline{\beta})R_C}=44.8\mu A$$

$$I_C=2.24mA$$

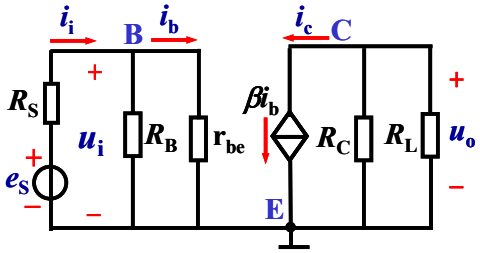
$$U_{CE}\approx 7.52V$$



6-6 在图 8-52 所示电路中，已知 V_{CC}=12V，R_C=2.4kΩ，R_B=300kΩ，R_L=5.1kΩ，U_{BE}=0.7V，$\overline{\beta}=\beta=60$。(1)画出微变等效电路；（2）分别计算 R_L 断开和街上时的电压放大倍数 A_U；（3）计算输入电阻 r_i 和输出电阻 r_O



(1)



$$I_B=\frac{V_{CC}-U_{BE}}{R_B}=37.7\mu A$$

(2)

$$I_C=\overline{\beta}I_B=2.26mA$$

$$r_{be}=200+(1+\beta)\frac{26}{I_E}=890\Omega$$

$$R_L\text{断开}A_U=-\beta\frac{R_C}{r_{be}}=-162$$

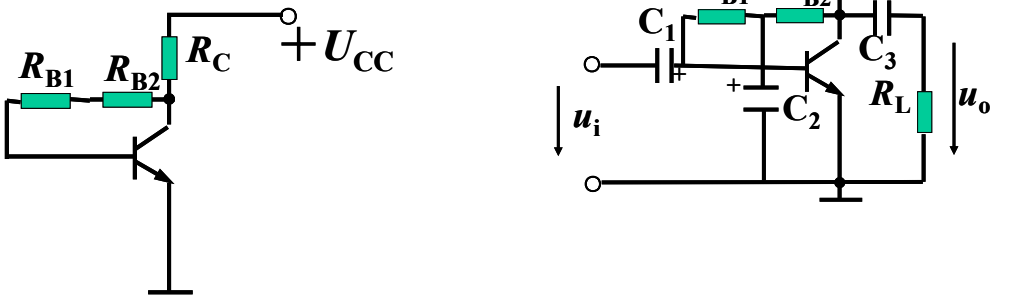
$$R_L\text{接上}A_U=-\beta\frac{R_L'}{r_{be}}=-110$$

(3)

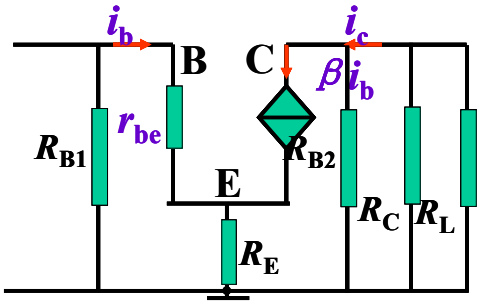
$$r_i=r_{be}=890\Omega, r_o=R_C=2.4k\Omega$$

6-7 在图 8-53 所示电路中，已知 V_{CC}=12V，R_C=2kΩ，R_{B1}= R_{B2}=75kΩ，R_L=2kΩ，U_{BE}=0.7V ，$\beta = 50$ ，r_{be}=910Ω。(1)画出直流通路（2）画出微变等效电路；（3）计算电压放大倍数 A_U、输入电阻 r_i 和输出电阻 r_O

（1）



（2）



（3）

$$A_U = -\beta\frac{R_L^{'}}{r_{be}} = -54, R_L^{'} = R_{B2} // R_C // R_L = 0.99k\Omega$$

$$r_i = r_{be} // R_{B1} \approx 910\Omega, r_o = R_C // R_{B2} \approx 2k\Omega$$

6-8 在图 8-54 所示电路中，已知 V_{CC}=12V，R_C=2kΩ，R_{B1}=33kΩ，R_{B2}=10kΩ，R_E=1kΩ，R_L=5.1kΩ，U_{BE}=0.7V ，$\beta = \overline{\beta} = 50$ ，U_s=10mV，R_s=1kΩ。(1)求静态值 I_B、I_C、U_{CE}（2）画出微变等效电路;（3）计算 r_{be} 、r_i 、r_O;（4）计算 U_i 和 U_o；(5)若 R_S=0，再求 U_0，并说明信号源内阻 R_s 对放大倍数的影响。

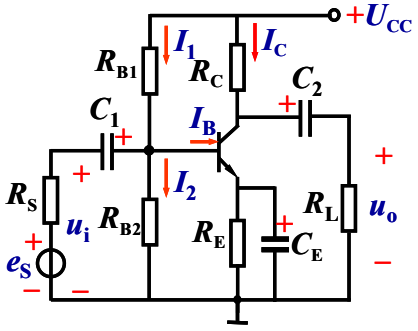
(1)

$$V_B = \frac{R_{B2}}{R_{B1}+R_{B2}}V_{CC} = 2.8V$$

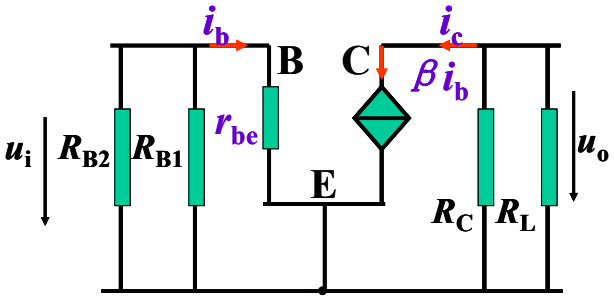
$$I_C \approx I_E = \frac{V_B - U_{BE}}{R_E} = 2.1mA$$

$$I_B = \frac{I_C}{\beta} = 42\mu A$$

$$U_{CE} = V_{CC} - I_C(R_C + R_E) = 5.7V$$



(2)



(3)

$$r_{be} = 200 + (1+\beta)\frac{26}{I_E} = 820\Omega$$

$$A_U = -\beta\frac{R_L^{'}}{r_{be}} = -88, R_L^{'} = R_C // R_L = 1.44k\Omega$$

$$r_i = r_{be} // R_{B1} // R_{B2} \approx 820\Omega, r_o = R_C = 2k\Omega$$

(4)

$$U_i = \frac{r_i}{r_i + R_S} = 4.5mV$$

$$U_O = A_U U_i = 396mV$$

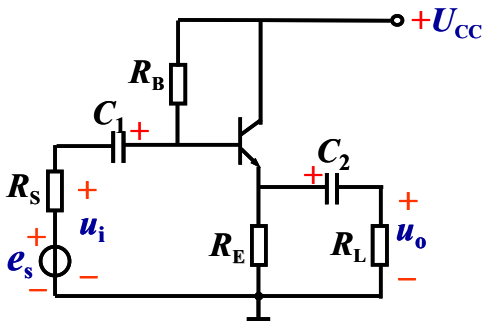
（5）

$$R_S = 0\text{时}U_i = \frac{r_i}{r_i + R_S} = 10mV$$

$$U_O = A_U U_i = 880mV$$

R_s 对放大倍数没有影响。

6-9 在图 8-55 所示电路中，已知 V_{CC}=12V，R_B=350k Ω，R_E= R_L =1k Ω，U_{BE}=0.7V ，$\beta = \overline{\beta} = 100$ 。(1)求静态值 I_B、I_C、U_{CE}（2）画出微变等效电路;（3）计算 A_U 、（4）计算 r_i 和 r_O



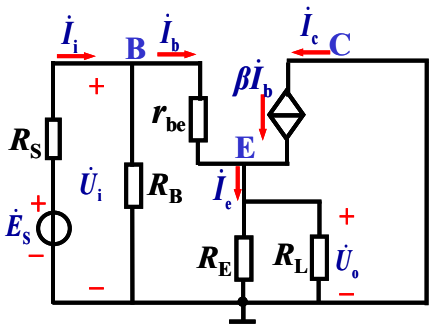
（1）

$$I_B = \frac{V_{CC} - U_{BE}}{R_B + (1+\beta)R_E} = 21\mu A$$

$$I_C = \beta I_B = 2.1mA$$

$$U_{CE} \approx V_{CC} - I_C R_E = 7.8V$$

（2）



（3）（4）

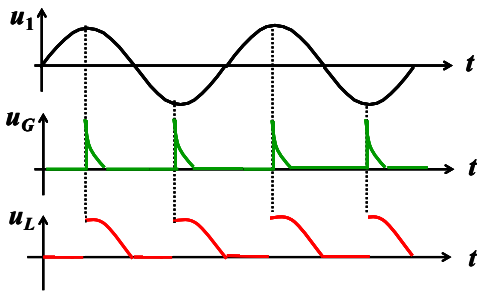
$$r_{be} = 200 + (1+\beta)\frac{26}{I_E} = 1440\Omega$$

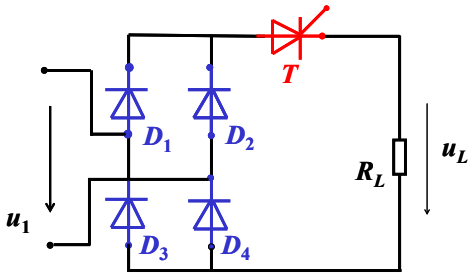
$$A_U = \frac{(1+\beta)R_L^{'}}{r_{be} + (1+\beta)R_L^{'}} = 0.986$$

$$r_i = [r_{be} + (1+\beta)R_L^{'}] // R_B = 79.2k\Omega, r_o = \frac{r_{be}}{\beta} = 14.4\Omega$$

7-1 分析图示电路的工作原理，说明是交流调压还是可控整流。若晶闸管的控制角 α =90°，画出负载电压 u_L 的波形。

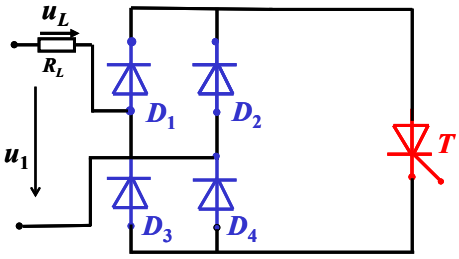
可控整流

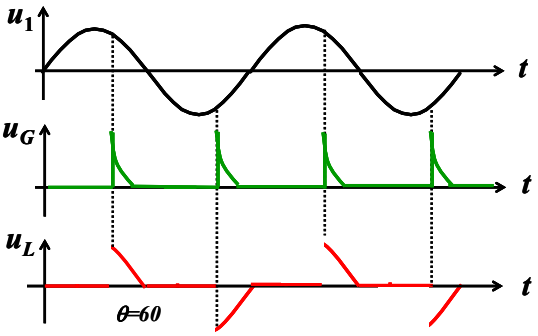




7-2 分析图示电路的工作原理，说明对负载 RL 而言是交流调压还是可控整流。若晶闸管的导通角 θ =60°，画出负载电压 u_L 的波形。

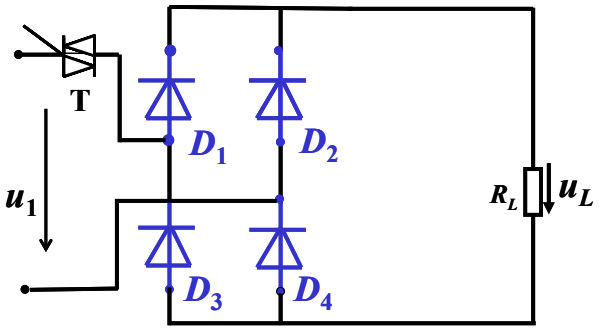
交流调压

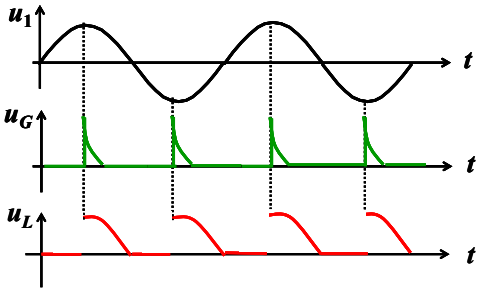




7-3 分析图示电路的工作原理，从电路结构和作用上与题 7-1 图比较，看其有何相同与不同。若 D1 开路，画出负载电压 u_L 的波形。

都是可控整流，题 7-1 图是先整流后斩波，本题图是先交流调压后整流。





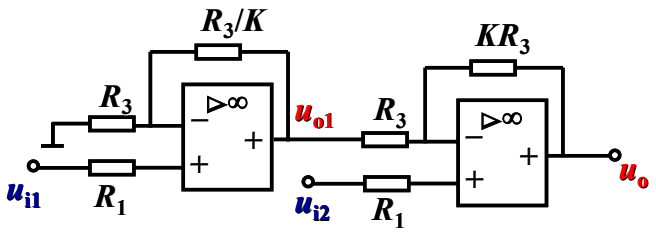
8-5 推导出图 10-28 中 u_o 与 u_{i1}、u_{i2} 的关系。

$$u_{01}=(1+\frac{R_3/K}{R_3})u_{i1}=(1+\frac{1}{K})u_{i1}$$

$$u_0=-\frac{KR_3}{R_3}u_{01}+(1+\frac{KR_3}{R_3})u_{i2}$$

$$=-K(1+\frac{1}{K})u_{i1}+(1+K)u_{i2}$$

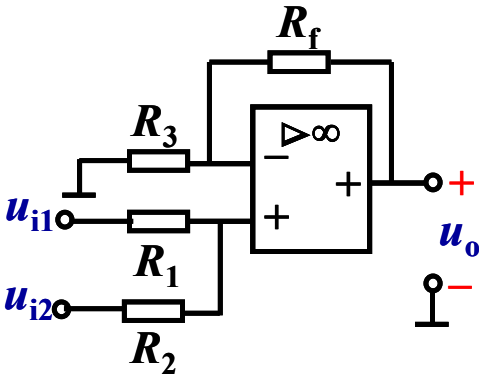
$$=(1+K)(u_{i2}-u_{i1})$$



8-6 图 10-29 为同相端输入加法电路，已知 $R_1=R_2$，$R_f=R_3$，求 u_o 与 u_{i1}、u_{i2} 的关系。

$$V_+=\frac{\frac{u_{i1}}{R_1}+\frac{u_{i2}}{R_2}}{\frac{1}{R_1}+\frac{1}{R_2}}=\frac{u_{i1}+u_{i2}}{2}$$

$$u_0=(1+\frac{R_f}{R_3})V_+=2V_+=u_{i1}+u_{i2}$$

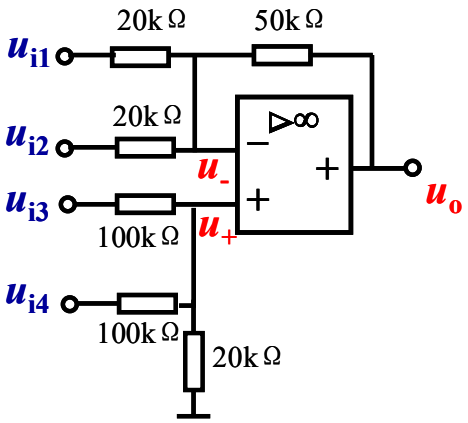


8-7 在图 10-30 中，求输出电压与各输入电压的关系。

$$V_+=\frac{\frac{u_{i3}}{100k}+\frac{u_{i4}}{100k}}{\frac{1}{100k}+\frac{1}{100k}+\frac{1}{20k}}=\frac{u_{i3}+u_{i4}}{7}$$

$$u_0=(1+\frac{50k}{20k//20k})V_+-\frac{50k}{20k}u_{i1}-\frac{50k}{20k}u_{i2}$$

$$=\frac{6}{7}(u_{i3}+u_{i4})-\frac{5}{2}(u_{i1}+u_{i2})$$

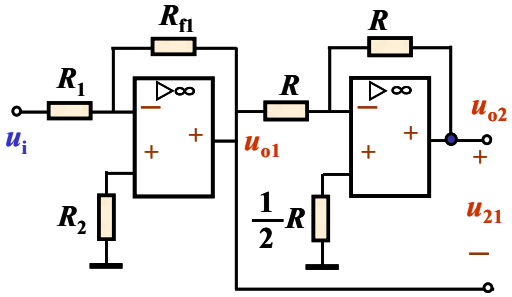


8-11 求图 10-34 运放的输出电压 u_{21}。

$$u_{01} = -\frac{R_f}{R_1}u_i$$

$$u_{02} = -\frac{R}{R}u_{01} = -u_{01}$$

$$u_0 = u_{02} - u_{01} = -2u_{01} = 2\frac{R_f}{R_1}u_i$$



8-12 证明图 10-35 中运放的电压放大倍数 $A_{uf} = \frac{u_o}{u_i} = -\frac{1}{R_1}(R_{f1} + R_{f2} + \frac{R_{f1}R_{f2}}{R_{f3}})$

$$V_+ = V_- = 0$$

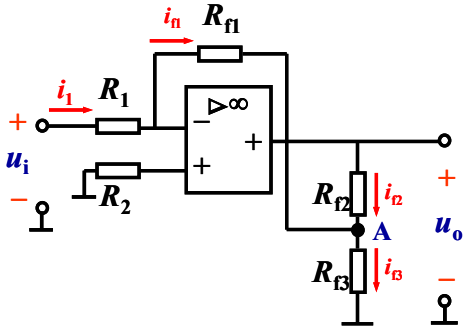
$$V_A = -\frac{R_{f1}}{R_1}u_i$$

$$V_A = \frac{\frac{u_0}{R_{f2}}}{\frac{1}{R_{f1}} + \frac{1}{R_{f2}} + \frac{1}{R_{f3}}} = -\frac{R_{f1}}{R_1}u_i$$

$$u_0 = -(\frac{1}{R_{f1}} + \frac{1}{R_{f2}} + \frac{1}{R_{f3}})\frac{R_{f1}R_{f2}}{R_1}u_i$$

$$= -\frac{1}{R_1}(R_{f1} + R_{f2} + \frac{R_{f1}R_{f2}}{R_{f3}})u_i$$

$$\therefore A_{uf} = \frac{u_o}{u_i} = -\frac{1}{R_1}(R_{f1} + R_{f2} + \frac{R_{f1}R_{f2}}{R_{f3}})$$

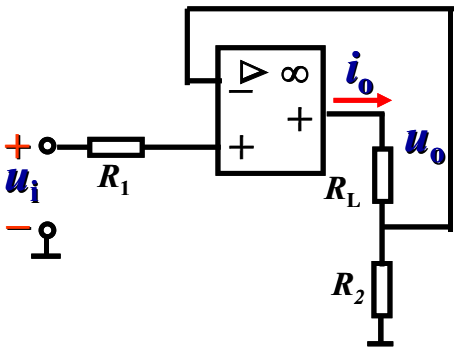


8-13 图 10-36 为电压电流转换电路，试求 i_o 与 u_i 的关系。

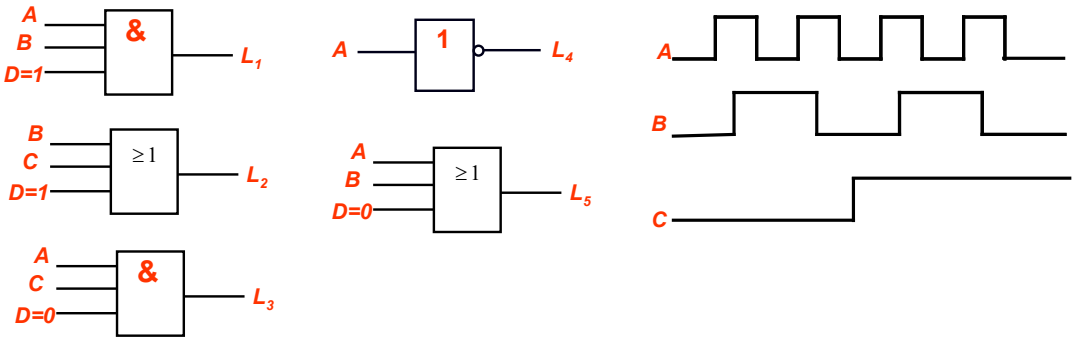
$$V_+ = V_- = u_i$$

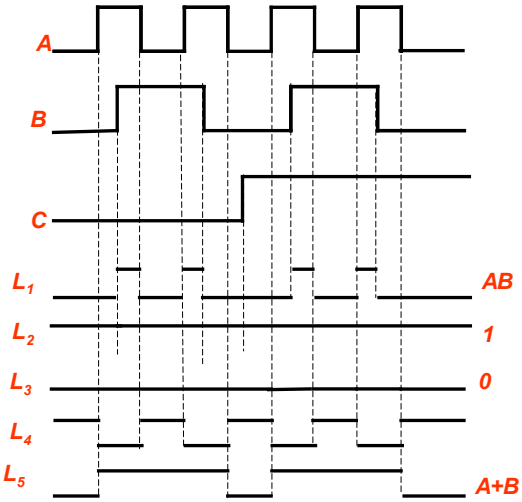
$$i_- = 0$$

$$i_0 = i_2 = \frac{V_-}{R_2} = \frac{u_i}{R_2}$$

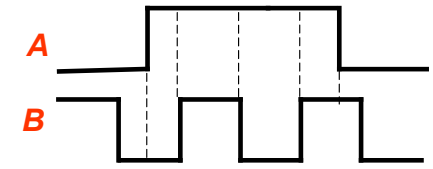


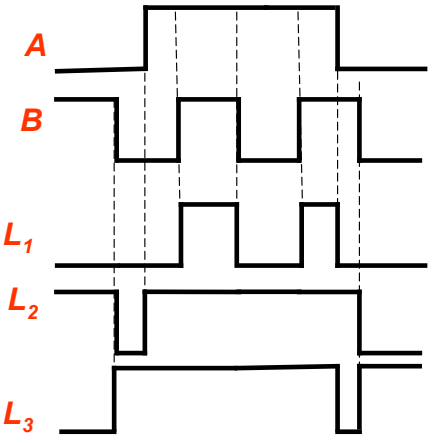
9-3 如图电路，已知输入波形如图所示，画出各图的输出波形。



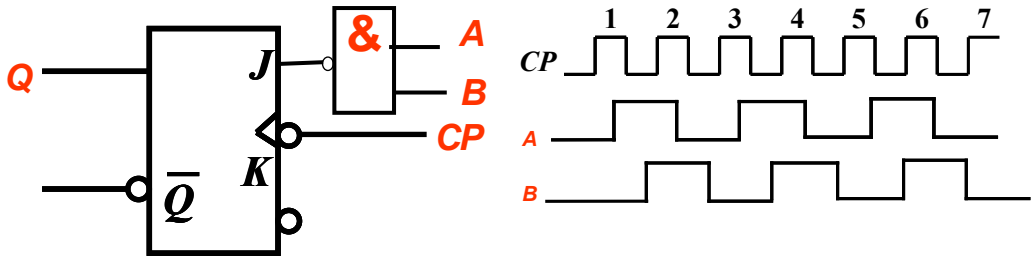


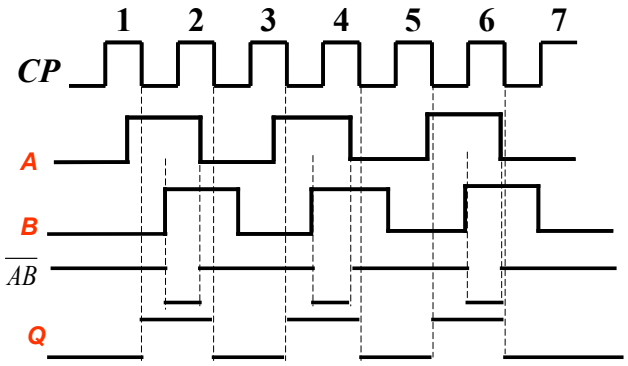
9-4 已知三个门电路的输入 A 和 B 波形如图所示，试画出 $L_1 = AB, L_2 = A + B, L_3 = A + \overline{B}$ 的输出波形。



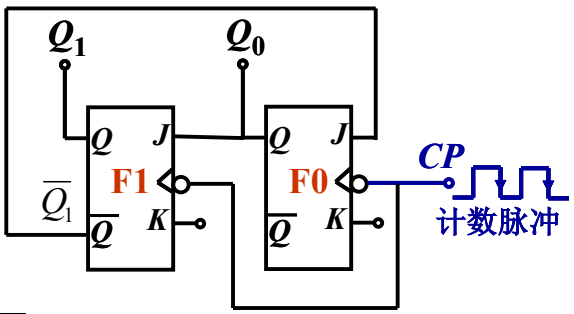


9-18 在图中，已知 A、B 及 CP 的波形，画出输出 Q 的波形（设起始时 Q=0）。





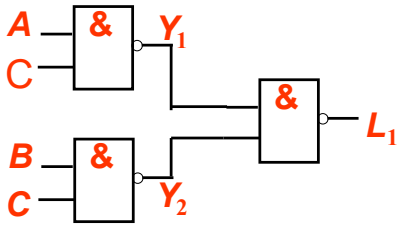
9-21 如图电路，若计数器的原始状态为 Q_1 Q_2=00。列出在计数脉冲作用下各触发器的状态表，指出是几进制计数器。



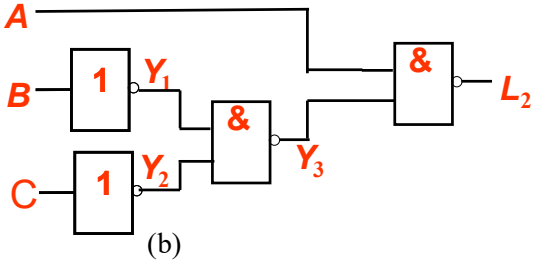
CP	Q_1	Q_0
1	0	0
2	0	1
3	1	0
4	0	0

是 3 进制计数器。

9-24 写出图中 L_1 L_2 的逻辑表达式。



(a)



(b)

（a）
$$Y_1 = \overline{AC}$$
$$Y_2 = \overline{BC}$$
$$L_1 = \overline{Y_1 Y_2} = \overline{\overline{AC}\,\overline{BC}} = AC + BC$$

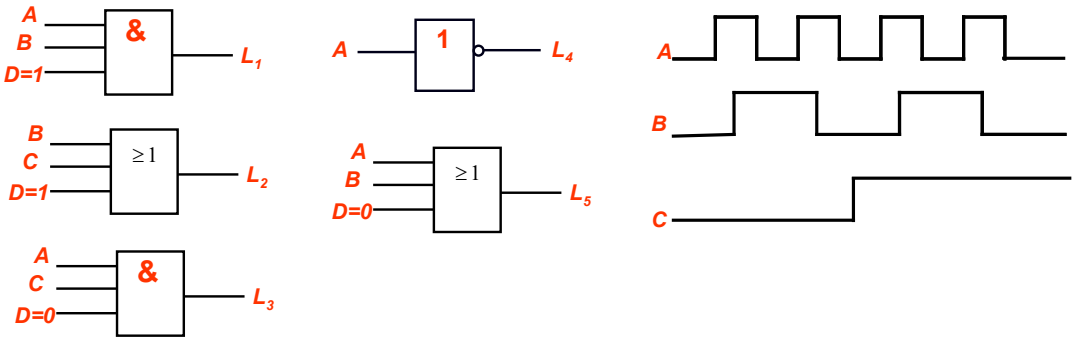
（b）
$$Y_1 = \overline{B}$$
$$Y_2 = \overline{C}$$
$$Y_3 = \overline{Y_1 Y_2} = \overline{\overline{B}\,\overline{C}} = B + C$$
$$L_2 = \overline{AY_3} = \overline{A(B+C)} = A + \overline{B}\,\overline{C}$$

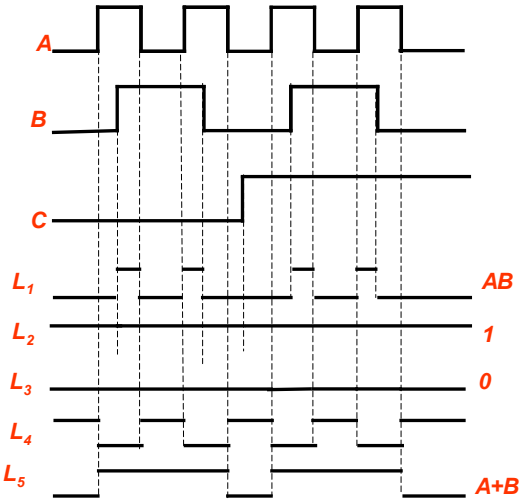
9-27 有 3 台电动机，规定其中主机 A 必须开机，副机 B 或 C 中至少有一台开机，否则指示灯 L 发光报警，设电动机开机为 1，停机为 0，指示灯亮为 1，灯灭为 0。列出逻辑状态表及表达式。

A	B	C	L
0	0	0	1
0	0	1	1
0	1	0	1
0	1	1	1
1	0	0	1
1	0	1	0
1	1	0	0
1	1	1	0

$$L = \overline{A}\,\overline{B}\,\overline{C} + \overline{A}\,\overline{B}C + \overline{A}B\overline{C} + \overline{A}BC + A\overline{B}\,\overline{C}$$
$$= \overline{A} + \overline{B}\,\overline{C}$$

9-3 如图电路，已知输入波形如图所示，画出各图的输出波形。





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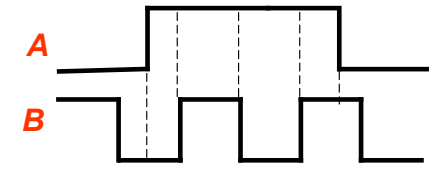

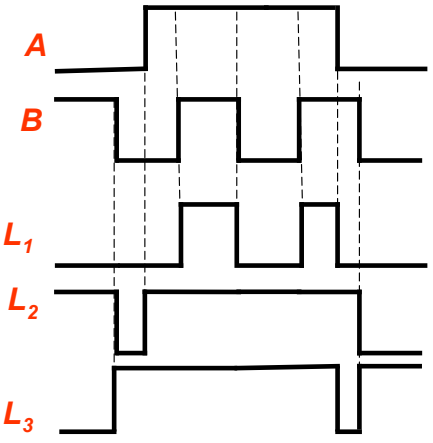

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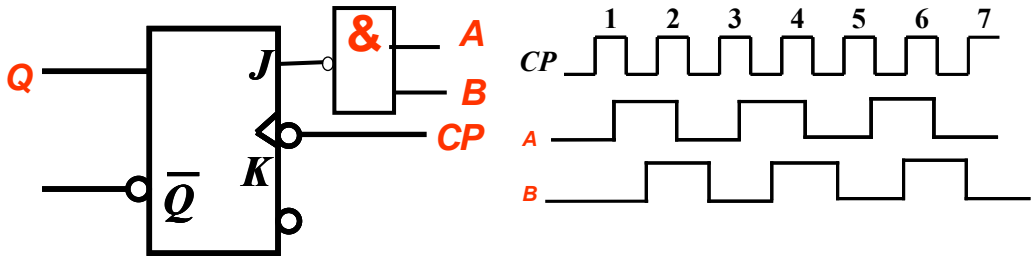

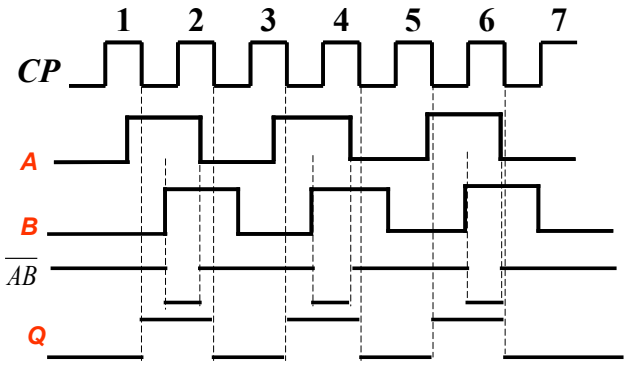

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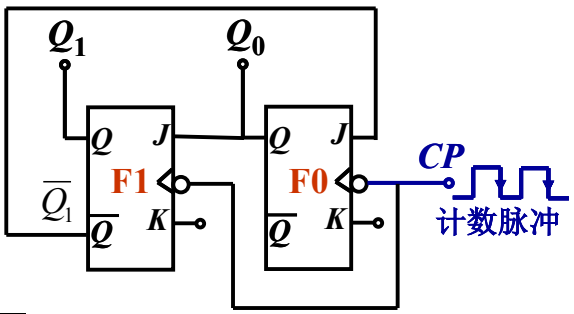

CP	Q_1	Q_0
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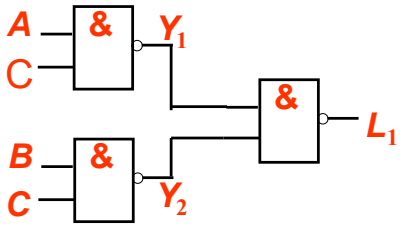
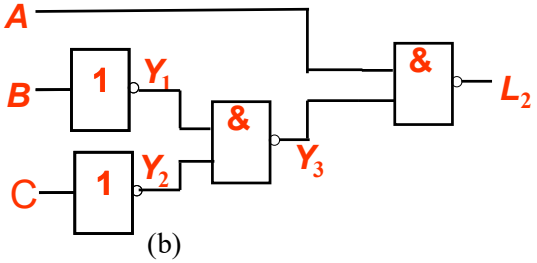
2	0	1
3	1	0
4	0	0

是 3 进制计数器。

9-24 写出图中 L_1 L_2 的逻辑表达式。



(a)



(b)

（a）
$$Y_1 = \overline{AC}$$
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$$L_1 = \overline{Y_1 Y_2} = \overline{\overline{AC}\,\overline{BC}} = AC + BC$$

（b）
$$Y_1 = \overline{B}$$
$$Y_2 = \overline{C}$$
$$Y_3 = \overline{Y_1 Y_2} = \overline{\overline{B}\,\overline{C}} = B + C$$
$$L_2 = \overline{AY_3} = \overline{A(B+C)} = A + \overline{B}\,\overline{C}$$

9-27 有 3 台电动机，规定其中主机 A 必须开机，副机 B 或 C 中至少有一台开机，否则指示灯 L 发光报警，设电动机开机为 1，停机为 0，指示灯亮为 1，灯灭为 0。列出逻辑状态表及表达式。

A	B	C	L
0	0	0	1
0	0	1	1
0	1	0	1
0	1	1	1
1	0	0	1
1	0	1	0
1	1	0	0
1	1	1	0

$$L = \overline{A}\,\overline{B}\,\overline{C} + \overline{A}\,\overline{B}C + \overline{A}B\overline{C} + \overline{A}BC + A\overline{B}\,\overline{C}$$
$$= \overline{A} + \overline{B}\,\overline{C}$$