北京理工大学

作业纸

课程名称：模电

班级：北京1909 教学班级：06011909 姓名：刘欣森 学号：1320191090 第 1 页

2-1 解：1. a；b；a；a.

2. b；

3. a；b.

4. a；a；b.

5. b；

2-4 解：A管是PNP型；B管是NPN型；

∵ $U_x > U_y > U_z$，$U_{yx} = -0.3V$

∴ y是基极b，x是发射极e，z是集电极c.

∵ 电位 $U_e > U_b > U_c$

∴ A管是PNP型

∵ $U_x > U_y > U_z$，$U_{xz} = 0.3V$

∴ x是基极b，z是发射极e，y是集电极c.

∵ 电位 $U_c > U_b > U_e$

∴ B管是NPN型

联系方式：

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2-7 解：(a) 该电路不能正常放大，应将 $+V_{CC}$ 改成 $-V_{CC}$ 将耦合电容极性反接.

(b) 该电路不能正常放大，应将电阻 R_B 接到 V_{CC} 上.

(c) 该电路不能正常放大，应将在基极与 V_{CC} 之间加基极电阻 R_B.

(d) 该电路不能正常放大，应将 R_B 接在 V_{CC} 上.

(e) 该电路可以正常放大.

(f) 该电路可以正常放大.

(g) 该电路不可以正常放大，应在集电极加电阻 R_C.

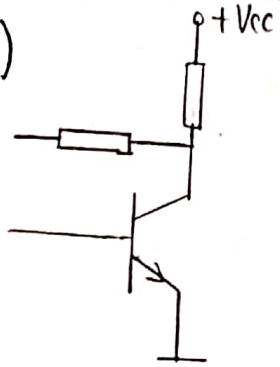
(h) 该电路不能正常放大，应将电容 C_B 去掉.

* 晶体管放大电路能否放大的判断准则：

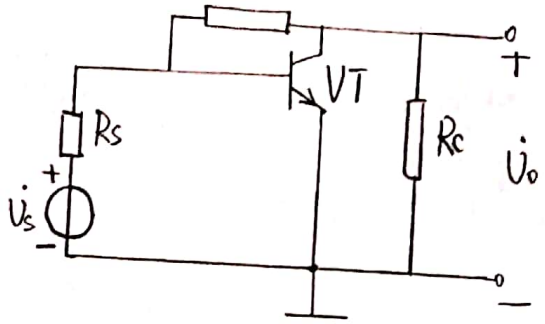
① 晶体管工作在放大区：发射结正偏，集电结反偏.

② 放大信号可以输入，输出：被放大信号能加在晶体管的输入端口，放大后信号能送到负载上.

2-8. 解：(a)



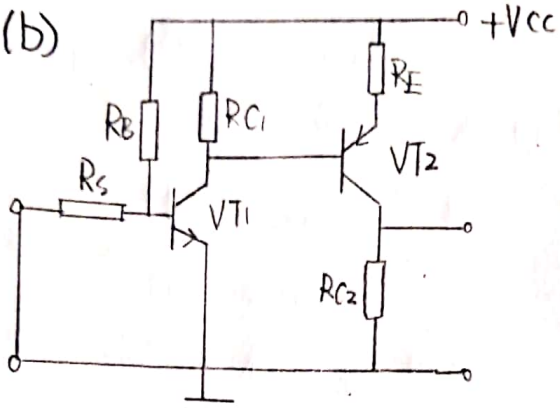
直流通路



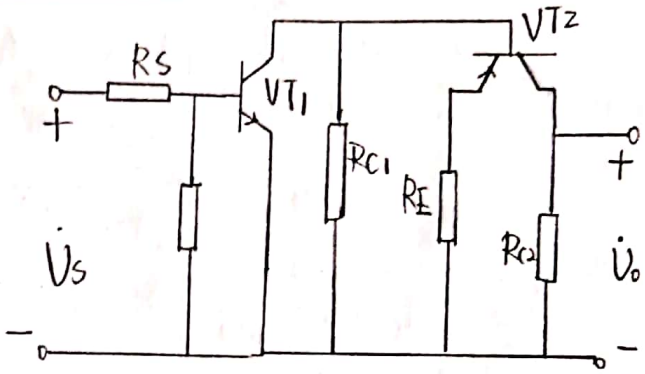
交流通路

联系方式：_____

(b)



直流通路

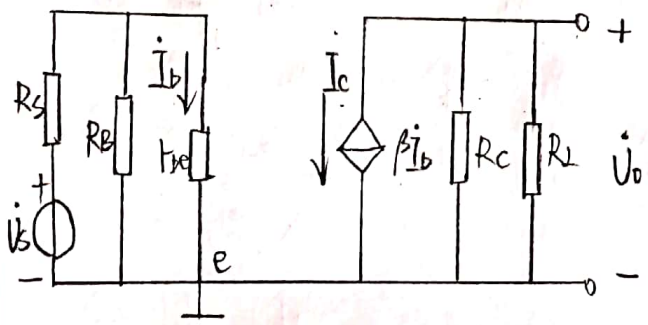


交流通路

2-14 解：(1) $I_{BQ}=\frac{I_{CQ}}{\beta}=10\mu A$

$$R_B=\frac{V_{CC}-U_{BEQ}}{I_{BQ}}=1.13\ M\Omega.$$

(2)



$$r_{be}=r_{bb'}+(1+\beta)\frac{26mV}{I_{EQ}}$$

$$=100+\frac{26}{10}\times10^3$$

$$=2700\Omega$$

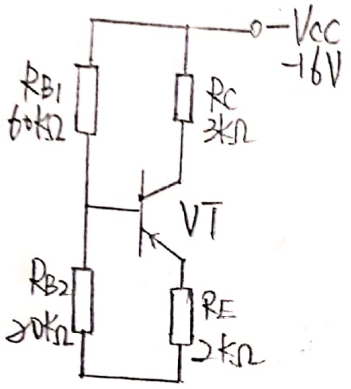
$$A_u=\frac{\dot U_o}{\dot U_i}=\frac{-\beta R_L'}{r_{be}}=-112$$

(3) $R_i=\frac{\dot U_i}{\dot I_i}=R_B//r_{be}\approx2.7\ k\Omega$

$$R_o=R_C=16\ k\Omega$$

$$\therefore A_{us}=\frac{\dot U_o}{\dot U_S}=\frac{R_i}{R_i+R_S}A_u=-83$$

2-15 解：(1)



$$\therefore U_B=\frac{R_{B2}}{R_{B1}+R_{B2}}(-V_{CC})=\frac{20k\Omega}{60k\Omega+20k\Omega}\times(-16)=-4V$$

$$I_{CQ}=\frac{U_B+0.3}{R_E}=\frac{-4+0.3}{2}=-1.85mA$$

$$\therefore U_{CEQ}=-V_{CC}+I_{CQ}(R_C+R_E)=-6.75V$$

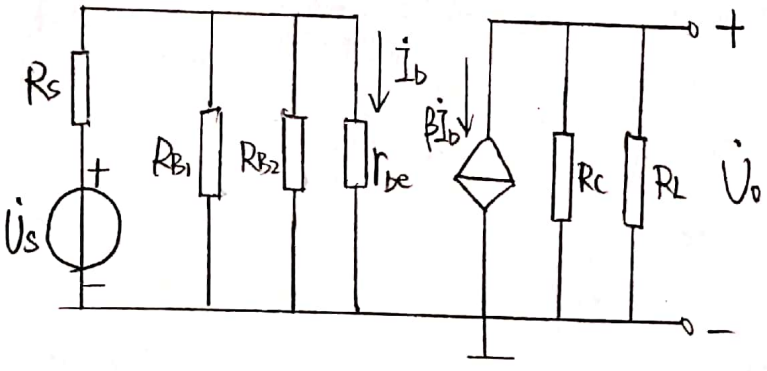
(2) $$\therefore I_{CQ}=\frac{-V_{CC}-U_{CEQ}}{R_C+R_E}=-2.4mA$$

$$U_B=I_{CQ}R_E=-2.4\times2=-4.8V$$

$$\because U_B=\frac{R_{B2}}{R_{B1}+R_{B2}}(-V_{CC})=-4.8V$$

$$\therefore R_{B1}=47k\Omega.$$

(3)



$$\therefore r_{be}=r_{bb'}+(1+\beta)\frac{26mV}{I_{EQ}}\approx1.3k\Omega$$

$$R_i=R_{B1}//R_{B2}//r_{be}\approx1.2k\Omega$$

$$\therefore A_{US}=\frac{\dot{U}_o}{\dot{U}_s}=-\frac{R_i}{R_i+R_s}\frac{\beta(R_C//R_L)}{r_{be}}=-55$$

$$\therefore R_o=R_C=3k\Omega.$$

2-16 解：

$$A_u=\frac{\dot U_o}{\dot U_i}=-\frac{\beta(R_C/\!/R_L)}{r_{be}}$$

$$R_i=R_{B1}/\!/R_{B2}/\!/r_{be}$$

$$r_{be}=r_{bb'}+(1+\beta)\frac{26}{I_{EQ}}\approx(1+\beta)\frac{26}{I_{EQ}}$$

$$I_{EQ}\approx\frac{V_B-V_{BE}}{R_E}$$

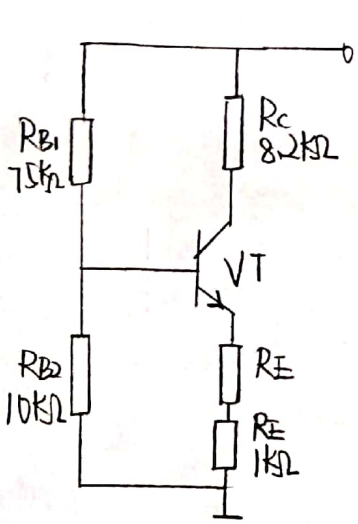
(1) 若 β↑，I_E不变，$A_u=-\frac{\beta R_C/\!/R_L}{r_{be}}\approx-\frac{(R_C/\!/R_L)I_{EQ}}{26mV}$ 不变

$R_i=R_{B1}/\!/R_{B2}/\!/r_{be}$ ↑

(2) 若 R_E↑，则 I_E↓，$A_u=-\frac{\beta R_C/\!/R_L}{r_{be}}\approx-\frac{(R_C/\!/R_L)I_{EQ}}{26mV}$ ↓

$R_i=R_{B1}/\!/R_{B2}/\!/r_{be}$ ↑.

2-17 解：



$$V_B=\frac{R_{B2}V_{CC}}{R_{B1}+R_{B2}}=2.12V$$

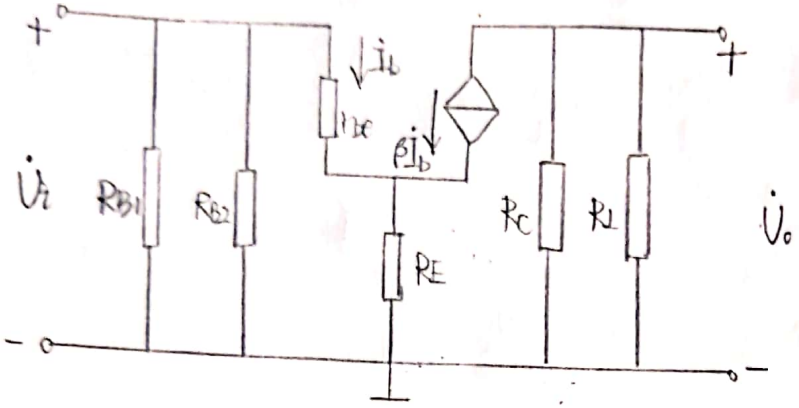
当 $R_E=0$ 时 $I_E=\frac{V_B-0.7V}{R_E+R_{E1}}=1.42mA$

$$r_{be}=r_{bb'}+(1+\beta)\frac{26mV}{I_E}=1.217k\Omega.$$

$$R_i=\frac{\dot U_i}{\dot I_i}=R_{B1}/\!/R_{B2}/\!/[r_{be}+(1+\beta)R_E]=1.63k\Omega$$

$$\therefore A_u=\frac{\dot U_o}{\dot U_i}=-\frac{\beta(R_L/\!/R_C)}{r_{be}+(1+\beta)R_E}=-1.74$$

$$R_o=R_C=8.2k\Omega.$$



当 $R_E=200\Omega$ 时

$$I_E=\frac{U_B-0.7}{R_E+R_{E1}}=1.18\,mA$$

$$r_{be}=r_{bb'}+(1+\beta)\frac{26mV}{I_E}=1.4k\Omega$$

$$A_u=\frac{\dot{U}_o}{\dot{U}_i}=\frac{-\beta(R_L/\!/R_C)}{r_{be}+(1+\beta)R_E}=-15.5$$

$$R_i=\frac{\dot{U}_i}{\dot{I}_i}=R_{B1}/\!/R_{B2}/\!/[r_{be}+(1+\beta)R_E]$$

$$=6.3k\Omega$$

$$R_o=R_C=8.2k\Omega$$

∴ $R_E=0$ 时 $A_u=-174$ $R_i=1.63\,k\Omega$ $R_o=8.2k\Omega$

$R_E=200\Omega$ 时 $A_u=-15.5$ $R_i=6.3k\Omega$ $R_o=8.2k\Omega$.

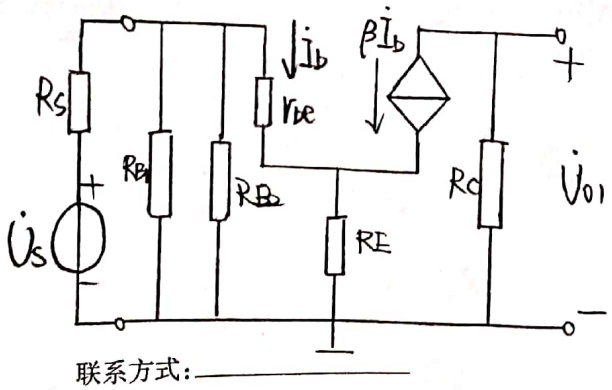
∴ 当射极电阻 R_E 增大时，电路的电压增益 $|A_u|$ 减小，输入电阻 R_i 增大。

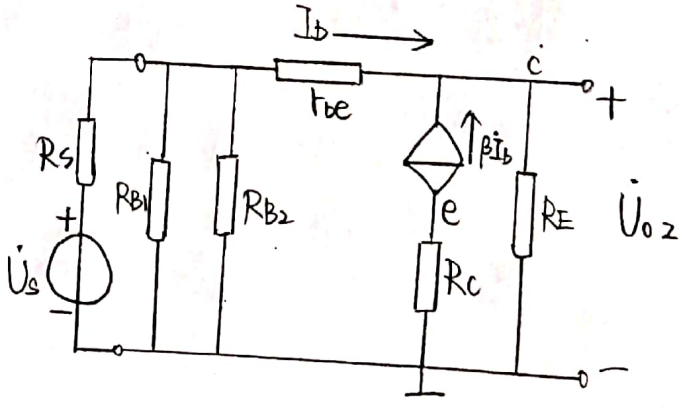
2-18 解：(1) $$U_B=\frac{R_{B2}V_{CC}}{R_{B1}+R_{B2}}=4.3\,V$$

$$I_{EQ}=\frac{U_B-0.7}{R_E}=1.8mA\approx I_{CQ}$$

$$U_{CEQ}=V_{CC}-I_{CQ}(R_C+R_E)=2.8\,V$$

(2)





联系方式：

$$r_{be} = r_{bb'} + (1+\beta)\frac{26mV}{I_E} = 1.2\,k\Omega$$

$$R_i = \frac{\dot{U}_i}{\dot{I}_i} = R_{B1} // R_{B2} // [r_{be} + (1+\beta)R_E] = 8.2\,k\Omega$$

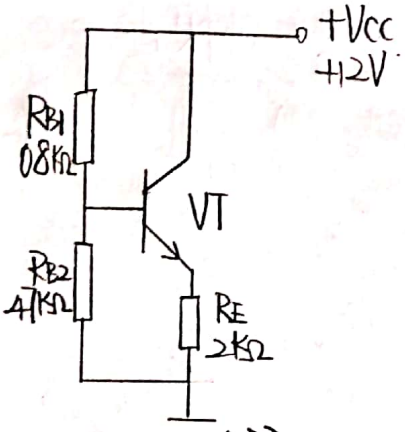
$$\therefore A_{us1} = \frac{\dot{U}_{o1}}{\dot{U}_s} = \frac{-\beta R_C}{r_{be}+(1+\beta)R_E} \cdot \frac{R_i}{R_1+R_s} = -0.79$$

$$A_{us2} = \frac{\dot{U}_{o2}}{\dot{U}_s} = \frac{(1+\beta)R_E}{r_{be}+(1+\beta)R_E} \cdot \frac{R_i}{R_1+R_s} = 0.797$$

(3) $\therefore R_{o1} = R_C = 2\,k\Omega$

$$R_{o2} = R_E // \frac{r_{be}+R_s // R_{B1} // R_{B2}}{1+\beta} = 33\,k\Omega.$$

2-19 解: (1)



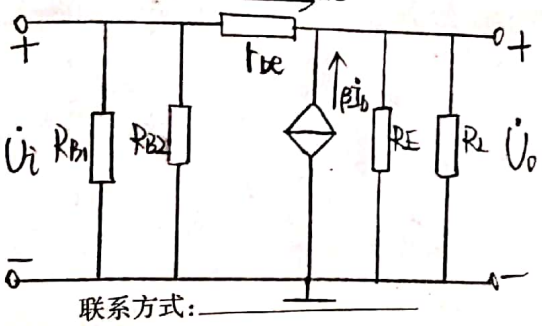
$$V_{BQ} = \frac{R_{B2}V_{CC}}{R_{B1}+R_{B2}} \approx 5V$$

$$I_{EQ} = \frac{V_{BQ}-0.7}{R_E} = 2.15\,mA$$

$$\therefore I_{CQ} = \frac{\beta I_{EQ}}{1+\beta} I_{EQ} \approx 2.1\,mA$$

$$V_{CEQ} = V_{CC} - I_{EQ}R_E = 7.7V$$

(2)



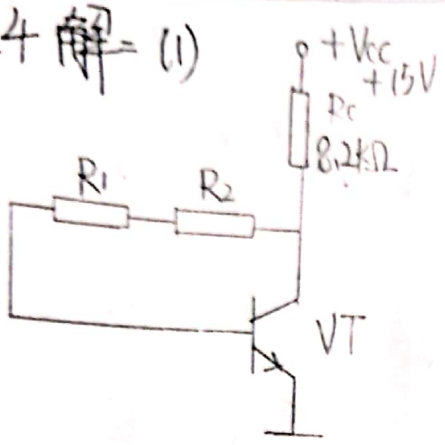
$$r_{be} = r_{bb'} + (1+\beta)\frac{26mV}{I_{EQ}} = 1.35\,\Omega$$

$$A_u = \frac{\dot{U}_o}{\dot{U}_i} = \frac{\dot{I}_e R_L'}{\dot{I}_b r_{be} + \dot{I}_e R_L'} = \frac{(1+\beta)R_L'}{r_{be}+(1+\beta)R_L'} = 0.987$$

$$R_i = R_{B1} // R_{B2} // [r_{be} + (1+\beta)R_L'] = 21.8\,k\Omega$$

$$R_o = R_E // \frac{r_{be}+R_s // R_{B1} // R_{B2}}{1+\beta} = 23\,\Omega$$

2-24 解：(1)



$$I_{CQ}=\beta I_{BQ}$$

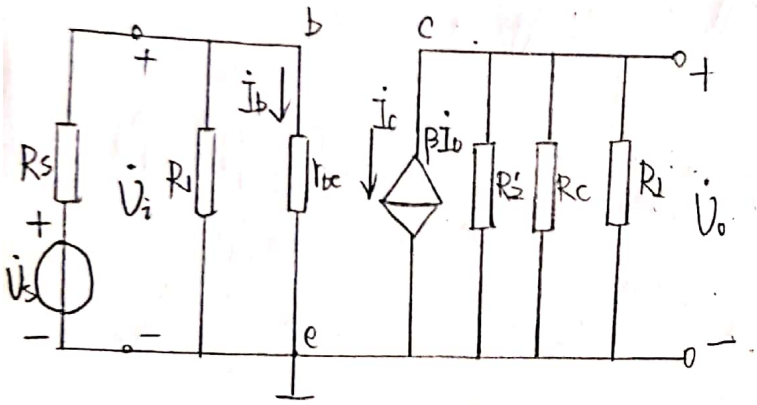
$$I_{RC}=I_{BQ}+I_{CQ}$$

$$\therefore \frac{V_{CC}-V_{CEQ}}{R_C}=I_{BQ}+\beta I_{BQ}$$

$$\therefore I_{BQ}=\frac{V_{CEQ}-V_{BEQ}}{2R_1}$$

$$\therefore R_1=R_2=62\,K\Omega.$$

(2)



$$r_{be}=r_{bb'}+(1+\beta)\frac{26mV}{I_{CQ}}=1.3\,K\Omega$$

$$A_u=\frac{\dot{U}_o}{\dot{U}_i}=\frac{-\beta(R_C/\!/R_L/\!/R_2)}{r_{be}}=-149$$

(3) $R_i=r_{be}/\!/R_1=1.3K\Omega$

$R_o=R_C/\!/R_2=7.3\,K\Omega$

$$A_{US}=\frac{\dot{U}_o}{\dot{U}_S}=\frac{R_i}{R_i+R_S}A_u=-83$$

2-25. 解：(1) ∵ $I_{CQ}=1mA$

∴ $I_{BQ}=10\mu A$，$I_{EQ}\approx 1mA$

∵ $V_{BQ}=\frac{R_{B1}V_{CC}}{R_{B1}+R_{B2}}=3.5V=5V_{BEQ}$

$$I_{EQ}=\frac{V_{BQ}-V_{BEQ}}{R_E}=\frac{2.8}{R_E}=1\ mA$$

∴ $R_E=2.8\ k\Omega$

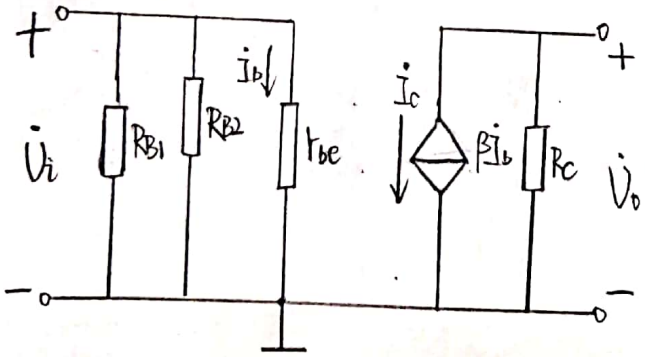
$$R_C=\frac{V_{CC}-(V_{BQ}-V_{BEQ})-V_{CEQ}}{I_{CQ}}=3.2\ k\Omega$$

∵ $I_1=0.1mA$，$I_C(R_{B1}+R_{B2})=V_{CC}$

$I_1R_{B1}=V_{B1}$

∴ $R_{B1}=35\ k\Omega$，$R_{B2}=85\ k\Omega$

(2)



$$A_u=\frac{-\beta R_C}{r_{be}}=-193$$

$$R_i=R_{B2}\,//\,R_{B1}\,//\,r_{be}=2.4\ k\Omega$$

$$R_o=R_C=5.2\ k\Omega$$