北京理工大学

作业纸

课程名称：模拟电子技术基

班级：0601l907 教学班级： 姓名：李东辉 学号：1120192910 第 1 页

2-4. A管：$U_X > U_Y > U_Z$ ∴ Y是基极

$U_{XY} = 12 - 11.7 = 0.3V$

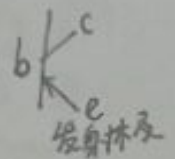
$U_{YZ} = 11.7 - 6 = 5.7V$ 是NPN，发射结正偏，集电结反偏，X是集电极，Z是发射极

B管：$U_Z < U_X < U_Y$

∴ X是基极

$U_{YX} = -1 + 5.2 = 4.2V$

$U_{XZ} = -5.2 + 5.5 = 0.3V$



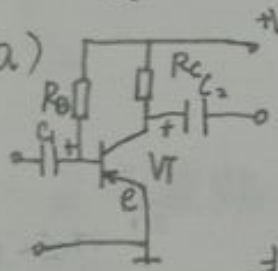
$U_b = -1V$，假设是PNP，则 $U_e = U_Z = -5.5V$

$U_c = U_Y = -1V$

∴ $U_e < U_b$，如果放大，应该 $U_e > U_b$ 与已知矛盾

∴ 是NPN，c是集电极，b是基极，e是发射极

2-7. a)



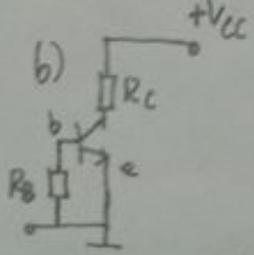
PNP型三极管

$U_e = 0$ $U_b > 0$

∴ $U_b > U_e$ 不能放大

将 $+V_{cc}$ 改为负电压

b)

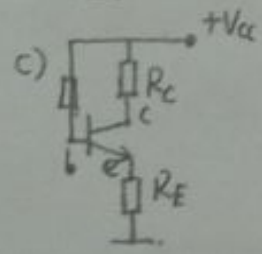


$U_b = i_b R_B$

$U_c = V_{cc} - \beta i_b \cdot R_c$

$U_e = U_c - U_{ce}$ 能正常放大

c)



NPN. $U_b = V_{cc} > U_c$ 不能放大.

在b和 V_{cc} 间加电阻

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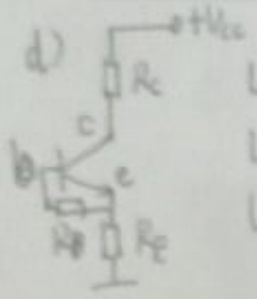
d)



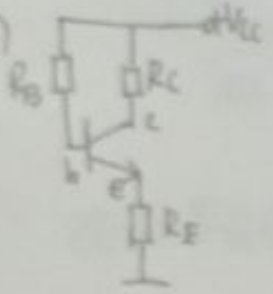
$U_E = V_{EE} - R_{iB} R_E$

$U_E = V_{EE} - R_{iB} - U_{BE}$

$U_B = i_B R_B + U_E$

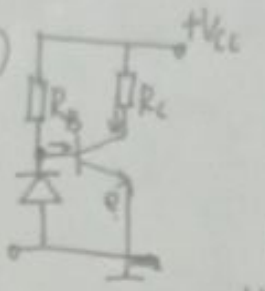
能放大

e)



能放大

f)



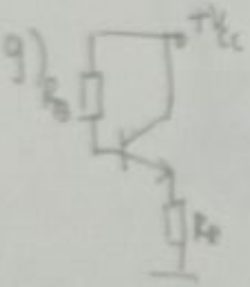
二极管处于反向截止状态，

不能放大

因为一半的交流信号不能输入放

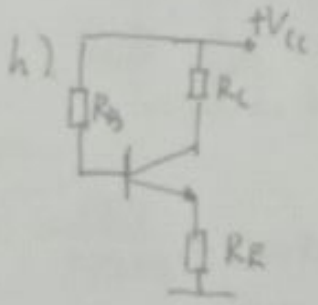
将二极管去掉

g)



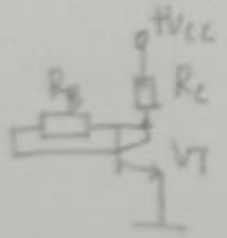
可以放大

h)

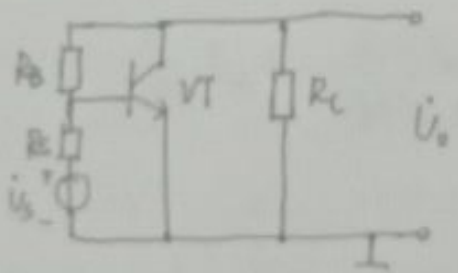


能放大

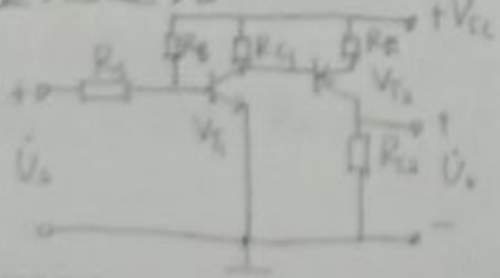
2-8. a) 直流通路：



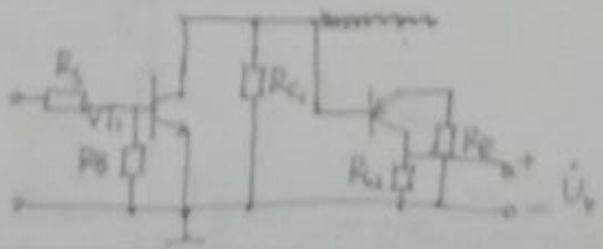
交流通路：



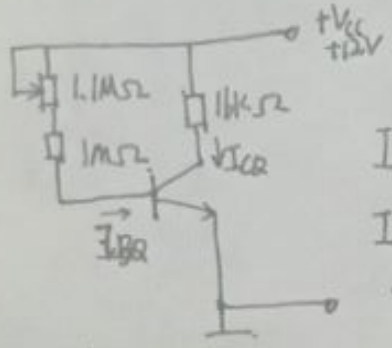
b) 直流通路：



交流通路：



2-14. 1. 直流通路：

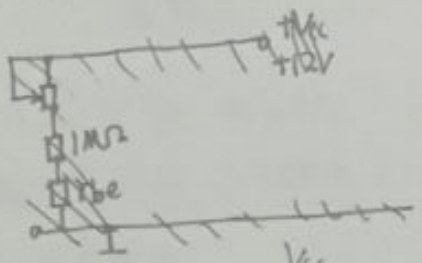


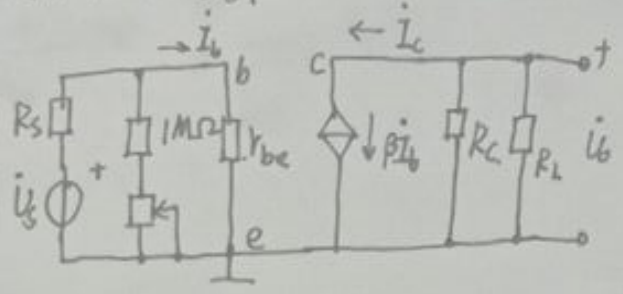
$I_{EQ} = (1+\beta) I_{BQ} = 51 \times \frac{0.5}{50} = 0.51mA$

$I_{BQ} = \frac{0.5}{50} = 0.01mA$

$r_{be} = r_{bb'} + (1+\beta)\frac{26}{0.51} = 100 + 51 \times \frac{26}{0.51} = 2700\Omega$

微变等效电路：





$R_B = \frac{V_{CC}}{I_{BQ}} = \frac{12V}{0.01mA} = 1200k\Omega$

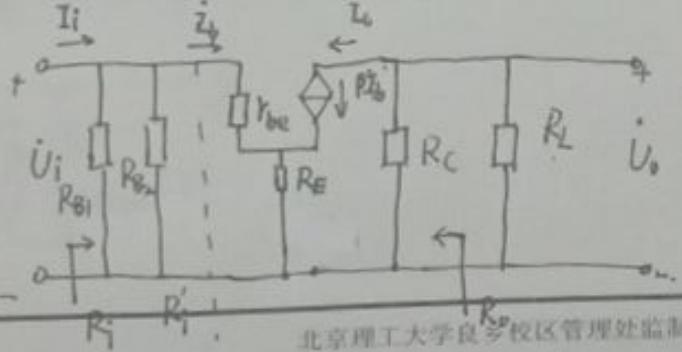
2. $A_u = \frac{\dot{U}_o}{\dot{U}_i} = -\frac{I_{CQ}(R_C // R_L)}{I_{BQ} r_{be}} = -\frac{50 \times \frac{16 \times 10}{26} \times 10^3}{2700} = -114$　　$R_i = R_B // r_{be} = 1200k\Omega // 2.7k\Omega \approx 2.7k\Omega$

$A_{us} = \frac{\dot{U}_o}{\dot{U}_s} = \frac{\dot{U}_o}{\frac{R_i + R_s}{R_i}\dot{U}_i} = \frac{R_i}{R_i + R_s} A_u = \frac{R_B // r_{be}}{R_B // r_{be} + R_s} A_u \approx -\frac{2.7}{2.7+1} \times 114 \approx 84$

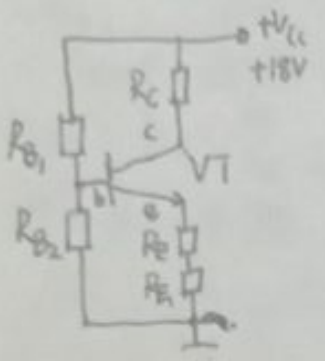
3. $R_i = 2.7k\Omega$　$R_o = R_C = 16k\Omega$

2-17. ①当 $R_E = 0$ 时：

微变等效电路：



直流通路：



$U_B \approx \frac{R_{B2}V_{CC}}{R_{B1}+R_{B2}} = \frac{10\times18}{10+185} = \frac{36}{17}V$

$I_{CQ} \approx I_{EQ} = \frac{U_B - U_{BE}}{R_E + R_{E1}} \approx \frac{\frac{36}{17}V}{1\,K\Omega} = \frac{36}{17}mA$

$\therefore I_{BQ} = \frac{\frac{36}{17}}{100} = \frac{0.36}{17}mA$

$\therefore r_{be} = r_{bb'} + (1+\beta)\frac{26}{\frac{36}{17}} = 100 + 101\times\frac{26\times17}{36} = 1.34\,K\Omega$

$A_u = \frac{\dot{U}_o}{\dot{U}_i} = \frac{-\dot{I}_c(R_C/\!/R_L)}{\dot{I}_b r_{be}} = \frac{-\beta(R_C/\!/R_L)}{r_{be}} = \frac{-100\times\frac{8.2\times6.2}{8.2+6.2}}{1.34} = -263$

$R_i' = \dot{U}_i/\dot{I}_b = r_{be} = 1.34K\Omega$

$R_i = R_{B1}/\!/R_{B2}/\!/R_i' = 1.16K\Omega$

$R_o = R_C = 8.2K\Omega$

当 $R_E = 200\Omega$ 时　$U_B = \frac{36}{17}V$

$I_{CQ} \approx I_{BQ} \approx \frac{\frac{36}{17}}{1.2} = \frac{30}{17}mA$

$r_{be} = 100 + 101\times\frac{26\times17}{30} = 1.59K\Omega$

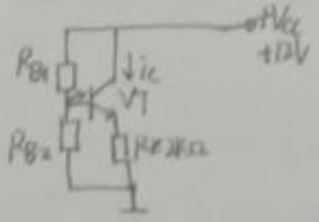
$A_u = \frac{\dot{U}_o}{\dot{U}_i} = \frac{-\dot{I}_c(R_C/\!/R_L)}{\dot{I}_b[r_{be}+(1+\beta)R_E]} = \frac{-100\times\frac{8.2\times6.2}{8.2+6.2}}{1.59+101\times0.2} = -16.2$

$R_i = R_{B1}/\!/R_{B2}/\!/[r_{be}+(1+\beta)R_E] = 10/\!/75/\!/21.79 = 6.2K\Omega$

$R_o = R_C = 8.2K\Omega$

R_E 增大，电路输入电阻增大，放大能力减弱

2-19. 1. 直流通路

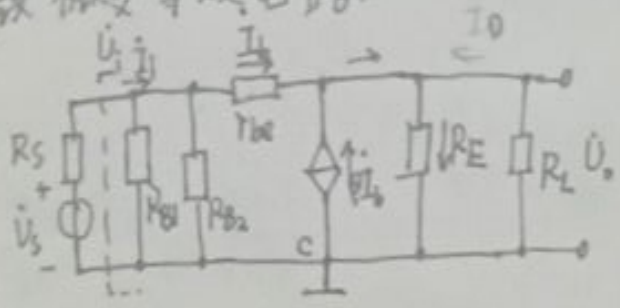


$$U_B \approx \frac{R_{B2}V_{CC}}{R_{B1}+R_{B2}} = \frac{47\times 12}{115} = 4.9V$$

$$I_{CEQ} \approx I_{EQ} = \frac{U_B - U_{BE}}{R_E} = \frac{4.9-0.2}{2} = 2.35mA$$

$$U_{CEQ} = V_{CC} - R_E \cdot I_{EQ} = 12 - 4.7 = 7.3V$$

2. 微变等效电路：



$$r_{be} = r_{bb'} + (1+\beta)\frac{26mV}{I_{EQ}} = 100 + 101\times\frac{26}{2.35} = 1.22K\Omega$$

$$A_u = \frac{(1+\beta)\dot{I}_b R_L'}{\dot{I}_b r_{be} + (1+\beta)\dot{I}_b R_L'} = \frac{(1+\beta)R_L'}{r_{be}+(1+\beta)R_L'} = \frac{101\times 1}{1.22+101} = 0.99$$

$$R_i = \frac{U_i}{\dot{I}_i} = \frac{(1+\beta)\dot{I}_b(R_E /\!/ R_L) + \dot{I}_b \cdot r_{be}}{\dot{I}_b} /\!/ R_{B1} /\!/ R_{B2}$$

$$= [101(R_E /\!/ R_L) + r_{be}] /\!/ R_{B1} /\!/ R_{B2}$$

$$= 21.9K\Omega$$

$$\dot{I}_o = \dot{I}_{RE} + (1+\beta)\dot{I}_b = \frac{\dot{U}_o}{R_E} + (1+\beta)\frac{U_o}{r_{be}+R_S'} \qquad R_S' = R_S /\!/ R_{B1} /\!/ R_{B2}$$

$$\therefore \frac{\dot{I}_o}{U_o} = \frac{1}{R_E} + \frac{1+\beta}{r_{be}+R_S'} \qquad \therefore R_o = \frac{\dot{U}_o}{\dot{I}_o} = R_E /\!/ \frac{r_{be}+R_S'}{1+\beta} = 23\Omega$$

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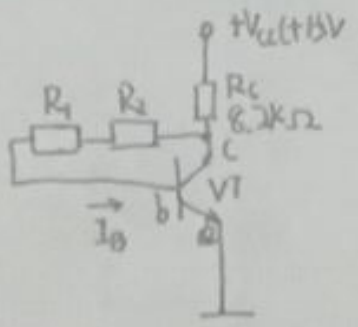
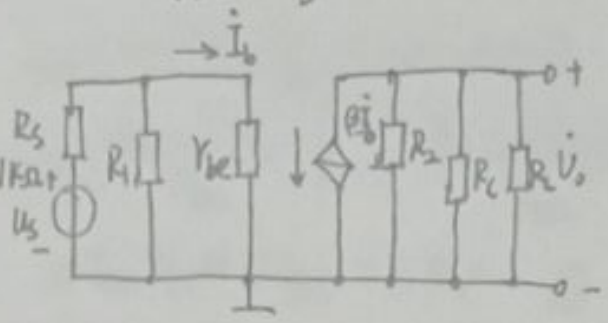
2-24 直流通路：



微变等效电路：



1. $U_{CQ}=U_{CEQ}=4V$

$I_{BQ}=0+0.7=0.7V$

$I_{BQ}=\frac{U_{CQ}-U_{BQ}}{2R_1}$

$I_{CQ}=\beta I_{BQ}=\frac{\beta(U_{CQ}-U_{BQ})}{2R_1}$

$R_c(I_{BQ}+I_{CQ})=15-4$

$\therefore 8.2\times10^3\times(1+50)\times\frac{4-0.7}{2R_1}=11$

$\therefore R_1=62730\Omega\approx63k\Omega=R_2$ ∴

$I_{BQ}=\frac{4-0.7}{2\times63}=0.26mA$

$I_{CQ}=\beta I_{BQ}=1.31mA$

$I_{EQ}=1.57mA$

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

$=300+51\times\frac{26}{1.57}$

$=1145\Omega$

2. $\dot{A}_u=\frac{\dot{U}_o}{\dot{U}_i}=\frac{-\beta\dot{I}_b(R_2/\!/R_c/\!/R_L)}{\dot{I}_b r_{be}}=\frac{-50\times(63/\!/8.2/\!/8.2)}{1.145}=-168$　$R_i=R_1/\!/r_{be}=1.12k\Omega$

$A_{us}=\frac{\dot{U}_o}{\dot{U}_s}=\frac{\dot{U}_o}{\frac{R_i+R_s\dot{U}_i}{R_i}}=\frac{1.12}{1.12+1}\times(-168)=-89$

3. $R_i=R_1/\!/r_{be}=1.12k\Omega$

$R_o=R_2/\!/R_c=6.3k\Omega/\!/8.2k\Omega=3.6k\Omega$

联系方式：

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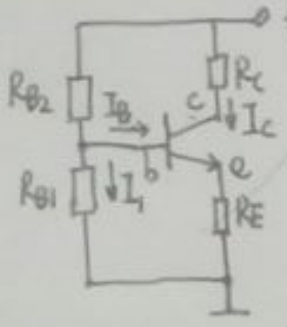
2.25 直流通路

1.



$U_{CEQ} = 12 - R_c \cdot I_{CQ} = 12 - 1mA \cdot R_c$ ①

$I_{BQ} = \frac{V_{cc} - I_1 R_{B1}}{R_{B2}} - I_1 = \frac{V_{cc} - 10 I_{BQ} R_{B1}}{R_{B2}} - 10 I_{BQ}$ ②

$10 I_{BQ} R_{B1} \approx 5 U_{BEQ} = 3.5V$ ③

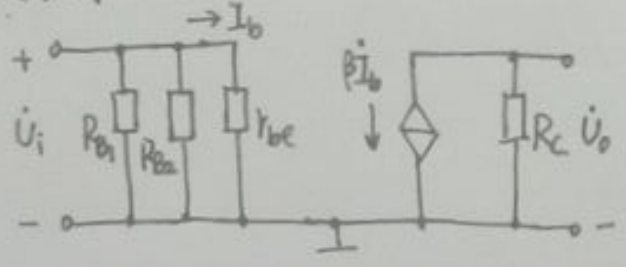
$U_{CEQ} = (1+\beta) I_{BQ} R_E + U_{CEQ} = 101 I_{BQ} R_E + 4$ ④

$I_{CQ} = \beta I_{BQ}$ ⑤

①~⑤联立，得：

$I_{BQ} = 0.01mA$　$R_{B1} = 35K\Omega$　$R_{B2} = 80k\Omega$　$R_c = 5.2k\Omega$　$R_E = 2.8k\Omega$

2. 微变等效电路：



$A_u = \frac{\dot{U}_o}{\dot{U}_i} = \frac{-\beta \dot{I}_b R_c}{\dot{I}_b r_{be}} = \frac{-100 \times 5.2}{2.7} = -193$

$R_i = \frac{\dot{U}_i}{\dot{I}_i} = r_{be} // R_{B1} // R_{B2} \approx 2.4K\Omega$

$R_o = R_c = 5.2k\Omega$