作 业 纸

课程名称：模拟电子技术基础

班级：0601107 教学班级： 姓名：王志远 学号：1120193014 第 页

思考习题 2-1 1. a, b, a, a 2. b 3. a, b 4. a, a, b 5. b

2-4 A: 由 $U_x > U_y > U_z$ 且 $U_{xy} < U_{yz}$ 可知

x为b发射极e y为基极b z为集电极c

且由 $U_e > U_b > U_c$ 可知 晶体管为PNP型

B: 由 $U_y > U_x > U_z$ 且 $U_{yx} > U_{xz}$ 可知

x为基极b y为集电极c z为发射极e

且由 $U_e < U_b < U_c$ 可知 晶体管为NPN型

2-9 (a) PNP管工作在放大区条件是 $U_e > U_b > U_c$，该电路不满足.

应将 $+V_{cc}$ 改为 $-V_{cc}$ 并改变电容极性

(b) 此时 $U_b = U_B = 0$，发射结零偏置，未工作在放大区，应将 R_B 与e极断开并接入 $+V_{cc}$

(c) $U_b > U_c$，晶体管处于饱和状态，应在 $+V_{cc}$ 与b极接入一个电阻 R_b 且在输入交流信号时，b极接地，无法输入，

(d) $U_b = U_e = 0$，晶体管未工作在放大区，应将 R_B 与e极断开并接 V_{cc}

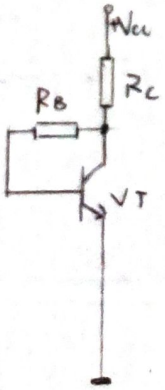
(e) 可正常放大

(f) 可正常放大

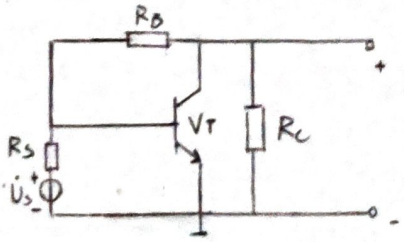
(g) 输入交流信号时，输出电压始终为0. 应在 V_{cc} 与c极间接电阻 R_c

(h) 输入交流信号时，C_B 视为短路，无法输入信号，应去掉 C_B

2-8 a) 直流：



交流：



作 业 纸

课程名称：

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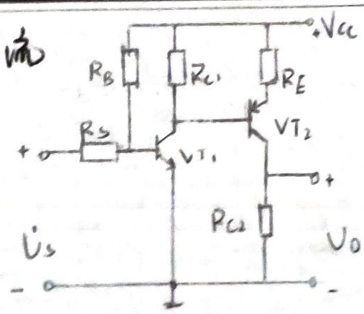
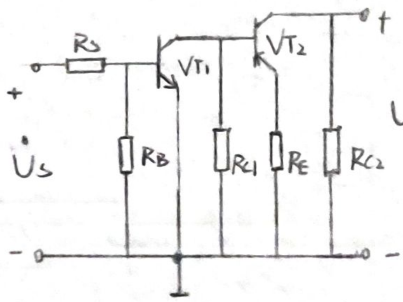
2-8 b) 直流 交流

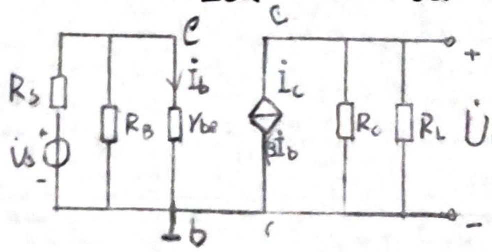




2-14 1. 对于前面工作点分析，有 ~~$I_{BQ} = \beta I_{BQ}$ 且 $I_{BQ} R_B = V_{cc} - U_{BEQ}$~~

$I_{BQ} = \frac{I_{CQ}}{\beta} = 10 mA$　$R_B = \frac{V_{cc}-U_{BEQ}}{I_{BQ}} = \frac{V_{cc}-U_{on}}{I_{BQ}} = 1.13\times MV$

2. 作出微变等效图：



$r_{be} = r_{bb'} + (1+\beta) r_{b'e'}$

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

$= 2700\Omega$　　$A_u = \frac{\dot{U}_o}{\dot{U}_i} = \frac{-\beta R_L'}{r_{be}} = -114$

3. $R_i = \frac{\dot{U}_i}{\dot{I}_i} = R_B // r_{be} \approx 2700\Omega$

故 $A_{us} = \frac{\dot{U}_o}{\dot{U}_s} = \frac{R_i}{R_i+R_s} A_u = -83$

$R_o = R_c = 16k\Omega$

2-15 1. 对于前面工作点分析，有：

~~$I_{BQ} = \frac{V_{cc}-U_{BE}}{R_{B1}}$~~　$U_B = \frac{R_{B2}}{R_{B1}+R_{B2}}(-V_{cc}) = -4V$

$I_{CQ} = \frac{U_B - U_{BE}}{R_E} = -1.85 mA$

$I_{BQ} = I_{CQ}/\beta = -0.62 mA$

$U_{CEQ} = U_C - U_E = (-V_{cc} - R_c \cdot I_{CQ}) - (U_B - U_{BE}) = -6.75V$

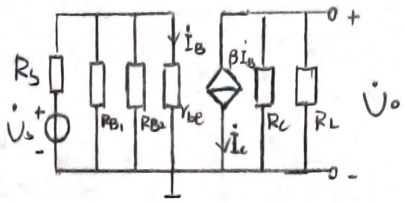
2. 由 1. 可知 $I_{CQ} = \frac{-V_{cc}-U_{CEQ}}{R_c+R_E} = -2.4 mA$

$U_B = I_{CQ}R_E + U_{BE} = -4.5V$　由 $U_B = \frac{R_{B1}}{R_{B1}+R_{B2}}(-V_{cc}) = -4.5V$

联系方式：

解得 $R_{B1} = 51.1 k\Omega$

2-15 作出相应微变等效图：



$r_{be} = r_{bb'} + (1+\beta)\frac{26mV}{I_{EQ}} = 0.96\ k\Omega$

$A_u = -\beta R_L' / r_{be} = -12$

$R_i = R_{B1} // R_{B2} // r_{be} \approx 0.96\ k\Omega$

$R_o = R_C = 3k\Omega$

$A_{us} = \frac{R_i}{R_i + R_s} A_u \approx -6.2$

思考 2-16 1) 增大 β $A_u = -\beta R_L' / r_{be} = \frac{-\beta R_C // R_L}{r_{bb'} + (1+\beta)\frac{26mV}{I_{EQ}}} \approx -\frac{(R_C // R_L) I_{EQ}}{26mV}$ 几乎不受其影响

$R_i = R_{B1} // R_{B2} // r_{be} \approx r_{be} = r_{bb'} + (1+\beta)\frac{26mV}{I_{EQ}}$ 增大

2) 增大 R_E 此时 I_E 减小 A_u 减小 R_i 增大

2-17 对前面工作点分析：此时 $U_B = \frac{R_{B2}}{R_{B1}+R_{B2}} \cdot V_{CC} = 2.12V$

① i° 当 $R_E = 0$ 时 $I_{EQ} = \frac{U_B - U_{on}}{R_E + R_{E1}} = 1.4mA$

此时 $r_{be} = r_{bb'} + (1+\beta)\frac{26mV}{I_{EQ}} = 1.95\ k\Omega$

$A_u = \frac{\dot{U}_o}{\dot{U}_i} = -\frac{\beta(R_L // R_C)}{r_{be} + (1+\beta)R_E} = -181$

$R_i = \frac{\dot{U}_i}{\dot{I}_i} = R_{B1} // R_{B2} // [r_{be} + (1+\beta)R_E] = 1.60k\Omega$

$R_o = R_C = 8.2k\Omega$

2° 当 $R_E = 200\Omega$ 时 $I_{EQ} = \frac{U_B - U_{on}}{R_E + R_{E1}} = 1.18mV$

$r_{be} = r_{bb'} + (1+\beta)\frac{26mV}{I_{EQ}} = 2.33\ k\Omega$

$A_u = \frac{\dot{U}_o}{\dot{U}_i} = -\frac{\beta(R_L // R_C)}{r_{be} + (1+\beta)R_E} = -15.7$ $R_i = R_{B1} // R_{B2} // [r_{be} + (1+\beta)R_E] = 6.34k\Omega$

$R_o = R_C = 8.2k\Omega$

3° 当 R_E 增大时可以使 $|A_u|$ 减小，R_i 增大

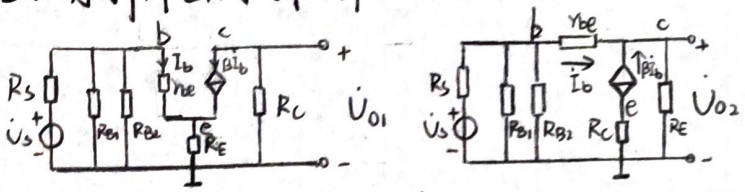
2-18 1. 对静态工作点进行分析：

$$U_B = \frac{R_{B2}}{R_{B1}+R_{B2}} \cdot (V_{cc}) = 4.29\,V$$

$$I_{CQ} \approx I_{EQ} = \frac{U_B - U_{BE}}{R_E} = 1.8\,mA$$

$$U_{CEQ} = U_C - U_E = (V_{cc} - R_C \cdot I_{CQ}) - (U_B - U_{BE}) = 2.81\,V$$

2. 分别作出两种输出的微变等效电路



$$r_{be} = r_{bb'} + (1+\beta)\frac{26mV}{I_E} \approx 0.88\,k\Omega$$

$$R_i = \frac{\dot{U}_i}{\dot{I}_1} = R_{B1} // R_{B2} // [r_{be} + (1+\beta) R_E] = 8.01\,k\Omega$$

$$A_{u1} = \frac{\dot{U}_{O1}}{\dot{U}_S} = \frac{-\beta R_C}{r_{be}+(1+\beta)R_E} \cdot \frac{R_i}{R_S+R_i} = -0.78$$

$$A_{u2} = \frac{\dot{U}_{O2}}{\dot{U}_S} = \frac{(1+\beta)R_E}{r_{be}+(1+\beta)R_E} \cdot \frac{R_i}{R_S+R_i} = -0.75$$

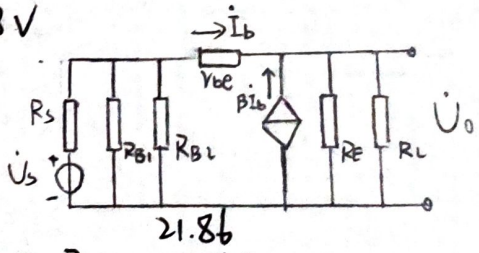
3. $R_i = 8.01k\Omega$ $R_{O1} = R_C = 3k\Omega$ $R_{O2} = R_E // \frac{r_{be}+(R_S // R_{B1} // R_{B2})}{1+\beta} = 33\Omega$

2-19 1. 对静态工作点分析

$$U_B = \frac{R_{B2}}{R_{B1}+R_{B2}} \cdot V_{cc} = 4.9\,V \quad I_{CQ} \approx I_{EQ} = \frac{U_B - U_{BE}}{R_E} = 2.1mA$$

$$U_{CEQ} = U_C - U_E = V_{cc} - I_{EQ} R_E = 7.8\,V$$

2. 作出微变等效电路



21.8b

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

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

$$R_o = R_E // \frac{r_{be}+R_S // R_{B1} // R_{B2}}{1+\beta} \approx R_E // \frac{r_{be}+R_S}{1+\beta} = 23.0\Omega$$

$$A_u = \frac{(1+\beta)R_L'}{r_{be}+(1+\beta)R_L'} = 0.99$$

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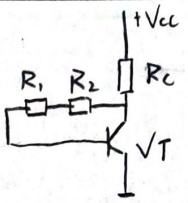
2-24. 直流通路如图所示

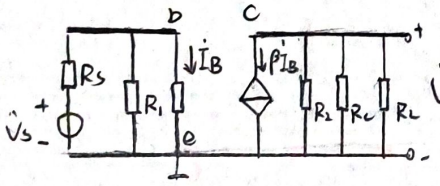


~~$I_{CQ} = \frac{V_{cc} - V_{CEQ}}{R_c} = 1.34mA$~~ $I_{BQ} = I_{CQ}/\beta$ = 26.8 μA

易知 $V_{cc} - V_{CEQ} = R_c \cdot (I_{BQ} + I_{CQ})$

且 $I_{CQ} = \beta I_{BQ}$ $I_{BQ} = \frac{V_{CEQ} - V_{BEQ}}{R_1 + R_2}$ 故 $R_1 = R_2 = 62.7$ kΩ

2. 作微变等效电路



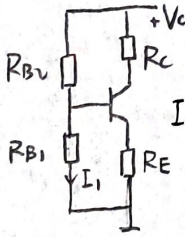
$r_{be} = r_{bb}' + (1+\beta)\frac{26mV}{I_{EQ}} = 1.3k\Omega$

$A_u = -\frac{\beta(R_2 // R_c // R_L)}{r_{be}} = -148$

$R_i = R_{be} // R_1 \approx 1.3k\Omega$ $A_{us} = A_u \frac{R_i}{R_i + R_s} = -83.7$

3. $R_i = 1.3k\Omega$ $R_o = R_c // R_2 = 7.3k\Omega$

2-25. 1. 作出直流通路图



由 $R_{B1} = \frac{U_{BQ}}{I_1}$ $I_1 \approx 10 I_{BQ}$ $U_{BQ} \approx 5 U_{BQ} =$ 3.5V

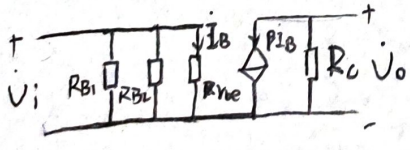
$I_{EQ} = \frac{U_{BQ} - U_{BEQ}}{R_E} \approx I_{CQ}$

$V_{cc} - U_{CEQ} \approx I_{CQ}(R_c + R_E)$ $I_{CQ} = \beta I_{BQ} = 1mA$

取整解得 $R_{B1} = 35k\Omega$ $R_{B2} = 85k\Omega$ $R_c = 5.2k\Omega$ $R_E = 2.8k\Omega$

2. 作出微变等效电路

~~$r_{be} = r_{bb}'$~~



$A_u = \frac{-\beta R_c}{r_{be}} = -192.6$

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

$R_o = R_c = 5.2k\Omega$