模拟电子技术基础第二章作业

1120192887
郭智源
06011907

2-1

1、a；b；a；a.
2. b.
3. a；b.
4. a；a；b
5. b

2-4

解：A：$U_X>U_Y>U_Z$
故Y为基极 $U_X-U_Y=0.3V$
∴X是发射极，Z是集电极
发射结正偏 ∴A是PNP型晶体管

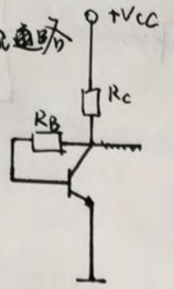
B $U_Y>U_X>U_Z$
∴X是基极 $U_Z-U_X=-0.3V$
Z是发射极，Y是集电极
发射结正偏 ∴B是NPN型晶体管

2-7

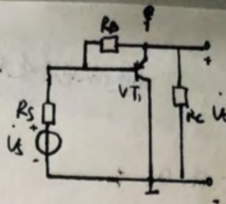
解：(a) 不能正常放大，集电极未能反偏，将+Vcc换成-Vcc
(b) 不能正常放大，基极无偏置电流，将R_B接至Vcc.
(c) 不能正常放大，基极电流交流短路，应在基极与Vcc中加RB.
(d) 不能正常放大，无偏置电流，将R_B接到Vcc上.
(e) 可以正常放大.
(f) 可以正常放大.
(g) ~~可以正常放~~ 不可以正常放大，交流时基集短路，应在Vcc与电容间加电阻
(h) 不可以正常放大，交流时基集短路，去掉C_B。

2-8

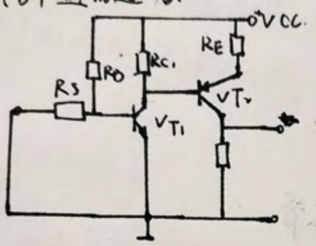
解 (a) 直流通路



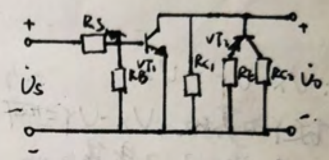
交流通路



(b) 直流通路



交流通路



2-14

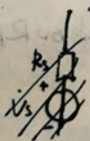
解 (1) $I_{BQ}=\frac{1}{\beta}I_{CQ}=10\mu A$.

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

(2) $A_u=\frac{U_o}{U_i}=-\frac{\beta R_L'}{r_{be}}=-\frac{\beta R_L'}{r_{bb'}+(1+\beta)\frac{U_T}{I_{EQ}}}=-\frac{100\times\frac{6\times10}{6+10}}{100+101\times\frac{26}{10}\times10^{3}}=-112$

$A_{us}=\frac{R_i}{R_i+R_s}A_u=-83$

(3) ~~...~~



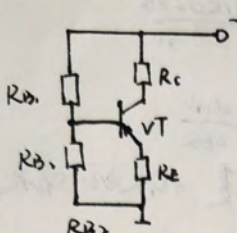
$R_i=\frac{U_i}{I_i}=R_B // r_{be}\approx2.7k\Omega$

$R_o=R_c=6k\Omega$

~~2-15 解 (1)~~

2-5

解：(1) 直流通路如下图所示



$U_{BQ}=\frac{R_{B2}}{R_{B1}+R_{B2}}(-V_{CC})=-4V$　　$I_{BQ}=\frac{U_{BQ}}{R_{B2}}=-2mA$

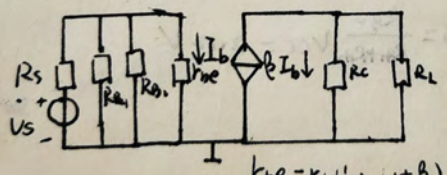
$I_{CQ}=\frac{V_B+0.7}{R_E}=-1.85mA$

(2) 若 $V_{CEQ}=-4V$

$I_{CQ}=\frac{-V_{CC}+V_{CEQ}}{R_C+R_E}=-2.4mA$　　$I_{BQ}=$

$U_B\simeq I_{CQ}R_E=-4.8V=\frac{R_{B2}}{R_{B1}+R_{B2}}(-V_{CC})\Rightarrow R_{B1}=47k\Omega$

(3) 微变等效电路如下图所示



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

$R_i=R_{B1}\parallel R_{B2}\parallel r_{be}\simeq 1.2k\Omega$

$R_o=R_C=3k\Omega$

$A_{us}=\frac{R_i}{R_i+R_s}A_u=\frac{R_i}{R_i+R_s}\cdot(-)\frac{\beta(R_C\parallel R_L)}{r_{be}}=-44$

解：(2) 微变等效电路如上图

$$A_u = -\frac{\beta(R_C // R_L)}{r_{be}} \approx \frac{\beta(R_C // R_L)}{(1+\beta)\frac{26mV}{I_{EQ}}} \approx \frac{(R_C // R_L) I_{EQ}}{26mV}$$

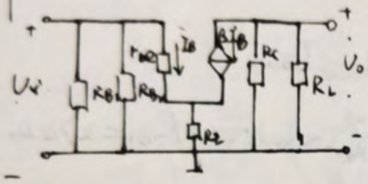
$R_i = R_{B1} // R_{B2} // r_{be}$ $\qquad r_{be} \approx (1+\beta)\frac{26mV}{I_{EQ}}$

(1) 由于 β 增大，I_E 基本不变，故 A_u 基本不变，输入电阻增大

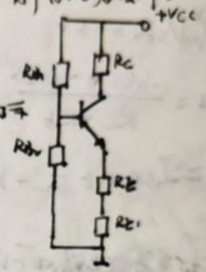
(2) 由于 R_E 增大，I_E 减小，A_u 减小，r_{be} 增大，R_i 增大。

2-17

解：微变等效电路如下 静态电路如下：



r_{be} = ... 时



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

$R_o = R_C = 8.2k\Omega$ $\qquad U_B = \frac{R_{B2}}{R_{B1}+R_{B2}} V_{CC} = 2.12V$

(1) 当 $R_E = 0$ 时，

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

$$r_{be} = r_{bb'} + (1+\beta)\frac{26mV}{I_E} = 1.27k\Omega$$

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

$$A_u = \frac{U_o}{U_i} = -\frac{\beta(R_L // R_C)}{r_{be} + (1+\beta)R_E} = -17x \qquad R_o = R_C = 8.2k\Omega$$

(2) 当 $R_E = 200\Omega$ 时，

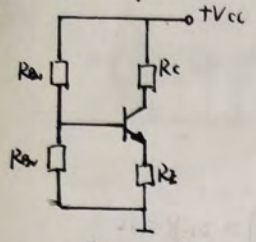
$$I_E = \frac{V_B - 0.7V}{R_E + R_{E1}} = 1.18mA \qquad r_{be} = r_{bb'} + (1+\beta)\frac{26mV}{I_E} = 1.xk\Omega$$

$$A_u = \frac{U_o}{U_i} = \frac{-\beta(R_L // R_C)}{r_{be} + (1+\beta)R_E} = -7.7 \qquad R_i = \frac{U_i}{I_i} = R_{B1} // R_{B2} // [r_{be} + (1+\beta)R_E] = 6.3k\Omega.$$

$R_o = R_C = 8.2k\Omega$ $\qquad R_E$ 增大时，A_u 减小，R_i 增大。

2-18

解：(1) 静态工作电路



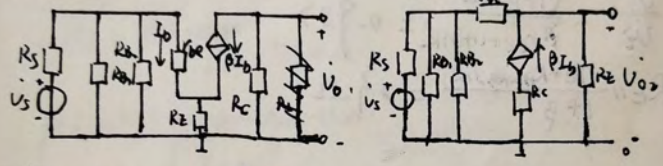
I_{CQ} =

$U_B = \frac{R_{B2}}{R_{B1}+R_{B2}} V_{CC} = 4.3V$

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

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

(2) 集电极输出电路　　共射极输出电路



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

$R_i = \frac{U_i}{I_i} = R_{B1} // R_{B2} // [r_{be} + (1+\beta)R_E] = 8.2k\Omega$

$A_{us1} = \frac{R_i}{R_s + R_i} \cdot [-\frac{\beta R_C}{r_{be} + (1+\beta)R_E}] \approx -0.79$

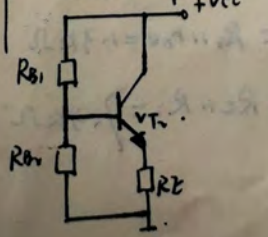
$A_{us2} = \frac{R_i}{R_i + R_s} \cdot \frac{(1+\beta)R_E}{r_{be} + (1+\beta)R_E} = 0.797$

(3) $R_i = 8.2k\Omega$　$R_{O1} = R_C = 2k\Omega$

$R_{O2} = R_E // \frac{r_{be} + R_{B1} // R_{B2} // R_S}{1+\beta} \approx 33\Omega$

2-19

解：(1) 直流静态工作电路为

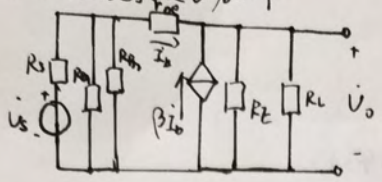


$U_B = \frac{R_{B2}}{R_{B1}+R_{B2}} V_{CC} \approx 3V$

$I_{EQ} = \frac{U_B - 0.7V}{R_E} = 2.3mA$　$I_{CQ} = \frac{\beta}{1+\beta} I_{EQ} \approx 2.3mA$

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

(2) 微变等效电路如下



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

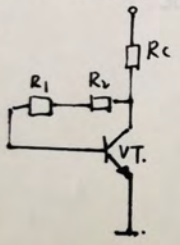
$$R_i = R_{B_1} // R_{B_2} // [r_{be} + (1+\beta)(R_E // R_L)] = 21.8k\Omega$$

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

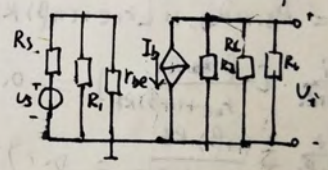
$$R_o = R_E // \frac{r_{be} + R_{B_1} // R_{B_2} // R_S}{1+\beta} = 23\Omega$$

2-2k

解：(1) 直流通路如下



微变等效电路如下



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

$I_{BC} = I_{BQ} + I_{CQ}$.

$\because (1+\beta) I_{BQ} = \frac{V_{CC} - U_{CEQ}}{R_C}$.

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

$\Rightarrow R_1 = R_2 = 62k\Omega$

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

(2) $A_u = -\frac{\beta(R_C // R_L // R_2)}{r_{be}} = -1 \times 9$

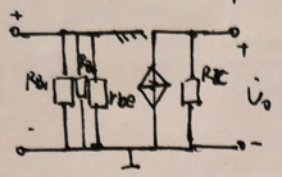
$A_{us} = \frac{R_i}{R_i + R_S} A_u = -8k$,

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

$R_o = R_C // R_2 = 7.3k\Omega$

2-2丁

解：(1) 微变等效电路如下



$$I_{BQ}=\frac{I_{CQ}}{\beta}=10\mu A \quad I_{EQ}\approx 1mA$$

$$U_{BQ}=\frac{R_{B1}}{R_{B1}+R_{B2}}V_{CC}=3.7V$$

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

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

$$\begin{cases} I_{\cdot}=0.1\ mA. \\ I_C=(R_{B1}+R_{B2})=V_{CC}\cdot \\ I_1R_{B1}=U_{B1} \end{cases} \Rightarrow \begin{cases} R_{B1}=37k\Omega \\ R_{B2}=83k\Omega \end{cases}$$

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

$R_o=R_C=3.2k\Omega$

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