2.4 A: ∵ $U_X - U_Y = 0.3V$　∴ U_X、U_Y 可能为 b、e 或 e、b 极

∴ $U_Z = 6V$ 为 c 极.

∵ U_Z 最小，即 c 极电压最小

∴ 为 PNP 型，∵ $U_C < U_b < U_e$

∴ Z: C极，　Y: b 极　　X: e 极

B: $U_X - U_Y = 0.3V$，∴ $U_Y = -1V$ 为 c极

∵ U_Y 也即 U_C 最大

∴ 为 NPN 型

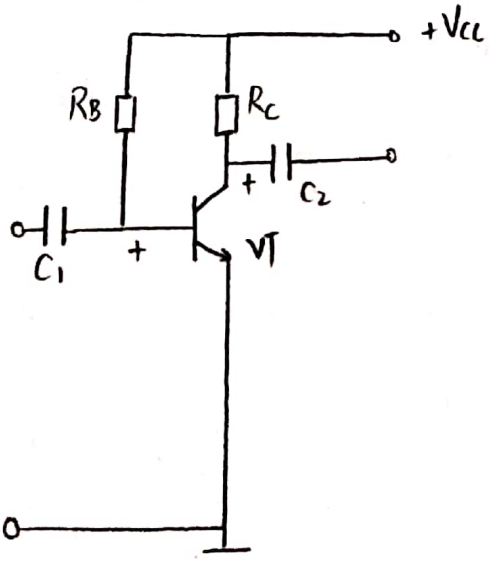
又∵ $U_C > U_b > U_e$

∴ Y: c极　　X: b极　　Z: e 极

2-7

a) 不能　$+V_{CC}$ 改为 $-V_{CC}$

b) 不能，改为：



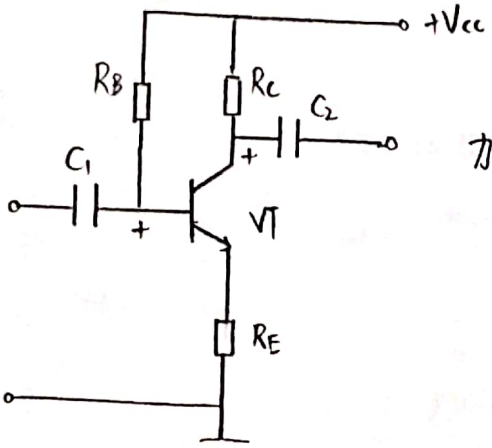
c) 不能　$+V_{cc}$ 与 b 极之间加上电阻 R_B

d) 不能　R_B 移到 $+V_{cc}$ 与 b 极之间

e) 能

f) 能

g) 不能

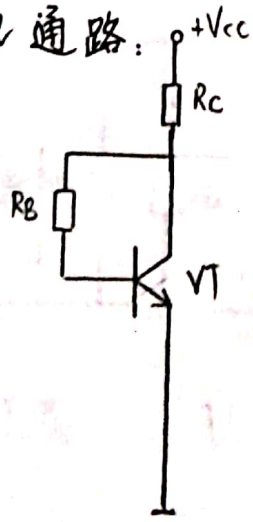


加上 R_C

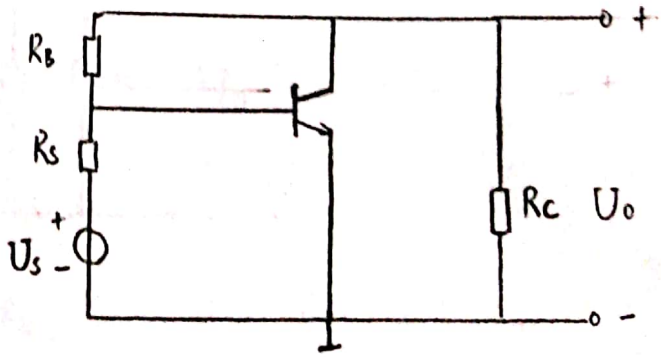
(h) 不能　去掉 C_B

2-8.

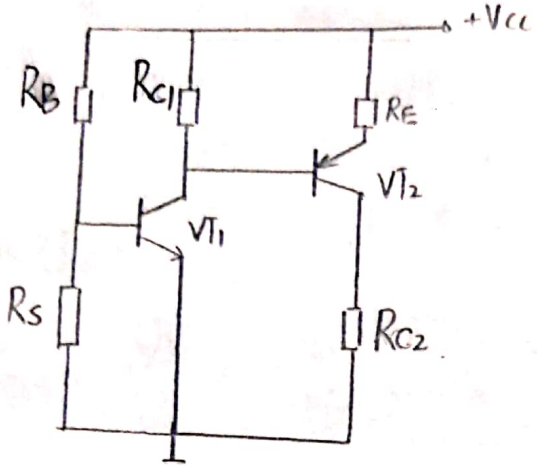
a) 直流通路：



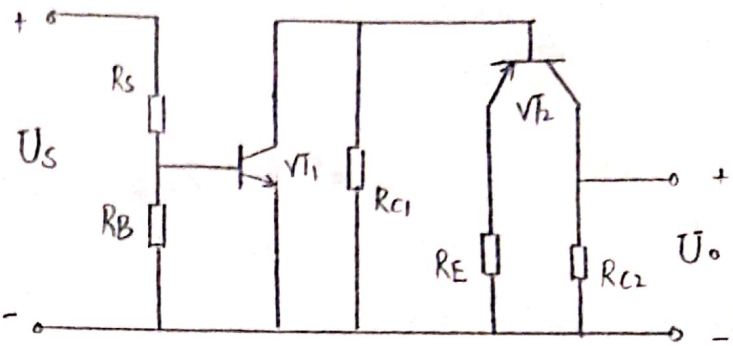
交流通路



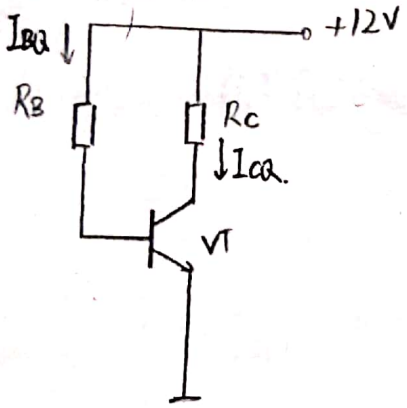
b) 直流通路：



交流通路



2-14. (1) 直流通路：



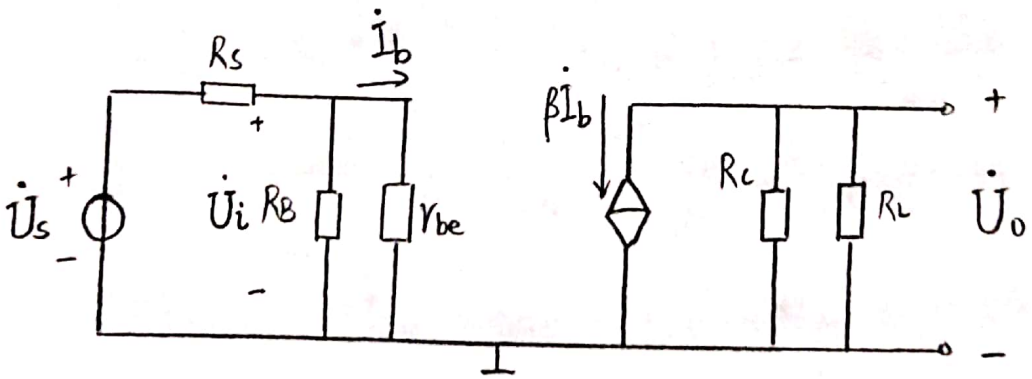
$U_{BEQ} \ll 12V$

$$\therefore I_{BQ} = \frac{V_{cc} - U_{BEQ}}{R_B} \approx \frac{V_{cc}}{R_B}$$

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

$$\therefore R_B = \frac{\beta V_{cc}}{I_{CQ}} = \frac{12V \times 50}{0.5mA} = 1.2M\Omega$$

(2) 微变等效电路：



$$\dot{U}_i = \dot{I}_b r_{be} \qquad \dot{U}_o = -\beta \dot{I}_b (R_c // R_L)$$

$$\therefore A_u = \frac{\dot{U}_o}{\dot{U}_i} = -\frac{\beta (R_c // R_L)}{r_{be}} \qquad r_{be} = r_{bb'} + (1+\beta)\frac{26mV}{I_{EQ}}$$

$$I_{EQ} = \frac{1+\beta}{\beta} I_{CQ}$$

$$\therefore r_{be} = r_{bb'} + \beta \frac{26mV}{I_{CQ}} = 2.7\,k\Omega$$

$$\therefore A_U = -\beta \cdot \frac{R_L // R_C}{r_{be}} = -114$$

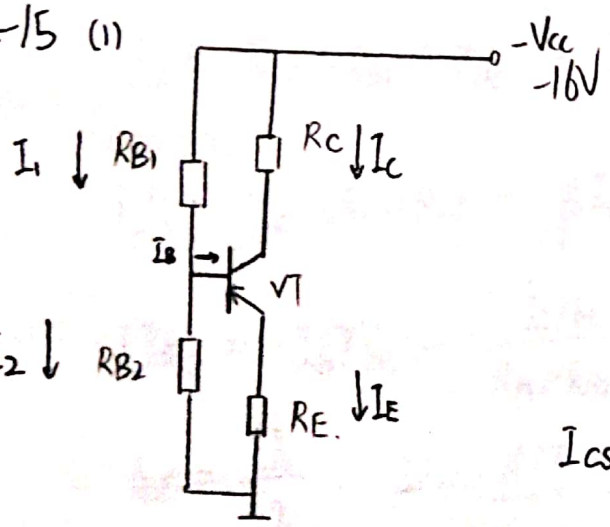
$$\dot{U}_S = \dot{U}_{RS} + \dot{U}_i \quad \because R_B \gg r_{be} \quad \therefore \dot{U}_S \approx \dot{I}_b (R_S + r_{be})$$

$$\therefore A_{US} = \frac{\dot{U}_i}{\dot{U}_S} = -\beta \frac{R_L // R_C}{R_S + r_{be}} = -83$$

(3) $R_i = R_B // r_{be} = 2.7\,k\Omega$

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

2-15 (1)



$V_{CC} = 16V$

$I_1 = I_2 + I_B \qquad I_1 \gg I_B$

$I_1 \approx I_B$

$$U_B \approx -\frac{R_{B2} V_{CC}}{R_{B1} + R_{B2}} = -4V$$

$$I_{CQ} \approx I_{EQ} = \frac{U_B - U_{BE}}{R_E} \approx \frac{U_B}{R_E} = -2mA$$

$$\therefore I_{BQ} = \frac{I_{CQ}}{\beta} = -0.033\,mA$$

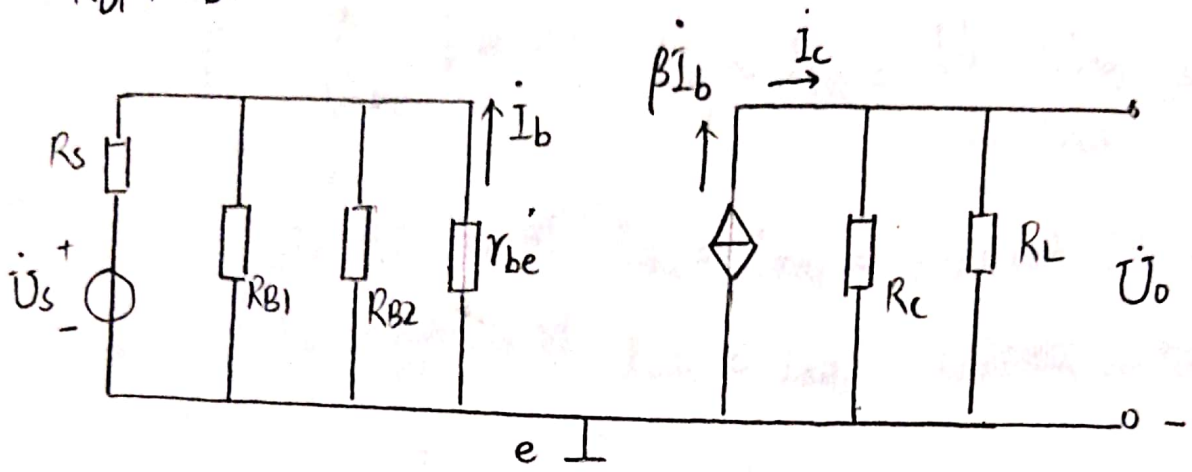
$$U_{CEQ} \approx -V_{CC} - I_{CQ}(R_C + R_{E1}) = -6V$$

(2) $U_{CEQ} = -V_{CC} - I_{CQ}(R_C + R_{E1}) = -4V \quad \therefore I_{CQ} = -2.4\,mA$

$\because U_B \approx I_{CQ} \cdot R_E = -2.4mA \times 2k\Omega = -4.8V$

$\therefore -\frac{R_{B2}V_{CC}}{R_{B1}+R_{B2}} = -4.8V \Rightarrow R_{B1} = 46.7k\Omega$

(3)



$R_o = R_c = 3k\Omega$

$r_{be} = (1+\beta)\frac{26mV}{|I_{EQ}|} = 793\Omega$

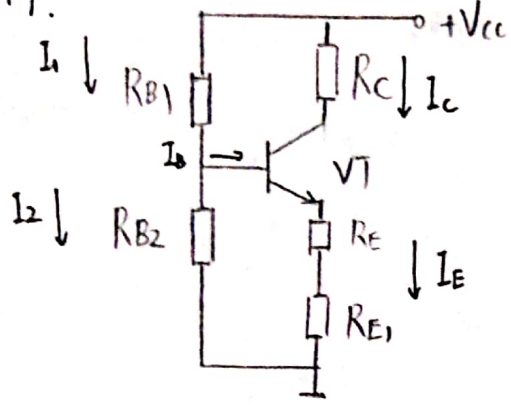
$R_i = R_{B1} // R_{B2} // r_{be} = 753.2\Omega$

$\dot{U}_o = I_c \cdot (R_c // R_L) = \beta \dot{I}_b (R_c // R_L)$

$\dot{U}_{is} = -\dot{I}_b r_{be} - \frac{\dot{I}_b r_{be}}{R_{B1} // R_{B2} // r_{be}} \cdot R_s = -\dot{I}_b \left(r_{be} + \frac{r_{be} R_s}{R_{B1} // R_{B2} // r_{be}}\right)$

$\therefore A_{us} = \frac{\dot{U}_o}{\dot{U}_s} = -\frac{\beta (R_c // R_L)}{r_{be}(1+\frac{R_s}{R_i})} = -65$

2-17.



$I_1 = I_2 + I_B$ ∵ $I_1 \gg I_B$

∴ $I_1 \approx I_2$

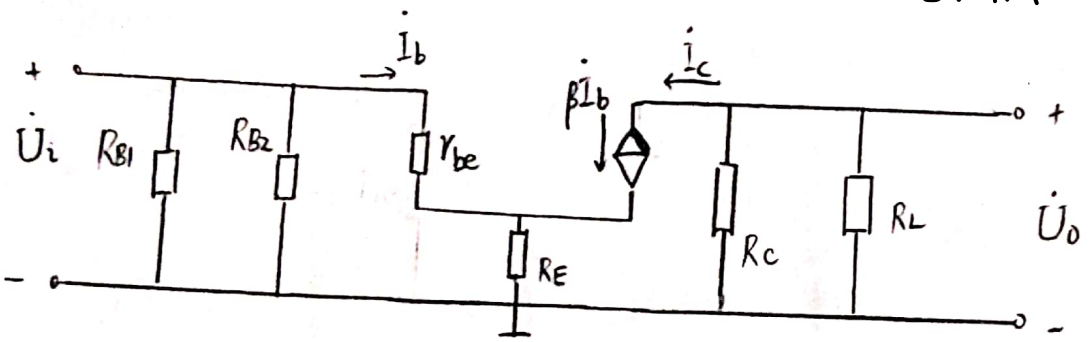
$U_{BEQ} = 0.7V$

∴ $U_B \approx \frac{R_{B2}}{R_{B1}+R_{B2}} V_{CC} = 2.12V$

$I_{CQ} \approx I_{EQ} = \frac{U_B - U_{BEQ}}{R_E + R_{E1}} = \frac{1.42}{R_E + R_{E1}}$

$R_E = 0\,\Omega$ 时 $I_{CQ1} \approx I_{EQ1} = 1.42\,mA$

$R_E = \frac{200}{200}\,\Omega$ 时 $I_{CQ2} \approx I_{EQ2} = 1.18\,mA$



$A_U = \frac{\dot{U}_o}{\dot{U}_i}$ $\dot{U}_o = -\dot{I}_c(R_C // R_L) = -\beta\dot{I}_b(R_C // R_L)$

$\dot{U}_i = \dot{I}_b \cdot [r_{be} + (1+\beta)R_E]$

∴ $A_U = -\frac{\beta(R_C // R_L)}{r_{be} + (1+\beta)R_E}$

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

⇒ $R_E = 0\,\Omega \Rightarrow A_{U1} = -181.1$

$R_E = 0.2k\Omega \Rightarrow A_{U2} = -15.7$

$R_o = R_C = 8.2\,k\Omega$ $R_i = \frac{\dot{U}_i}{\dot{I}_i} = R_{B1} // R_{B2} // (r_{be} + (1+\beta)R_E)$ ⇒ $R_E = 0$ $R_i = 1.59k\Omega$; $R_E = 200\Omega$ $R_i = 6.34k\Omega$

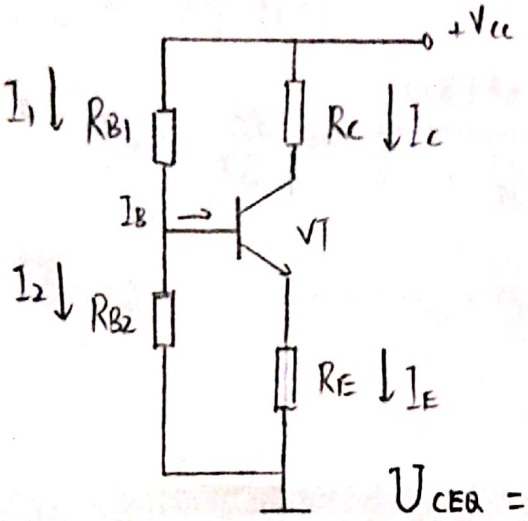
∴ $R_E = 0$: $A_U = -181.1$ $R_i = 1.59\,k\Omega$ $R_o = 8.2k\Omega$

$R_E = 200\Omega$ $A_U = -15.7$ $R_i = 6.34\,k\Omega$ $R_o = 8.2k\Omega$

R_E 越大，电压增益越小；输入电阻越大；输出电阻不变

联系方式：_____

2-18



(1) $I_1 = I_2 + I_B$ $I_1 \gg I_B$

$\therefore I_1 \approx I_2$

$U_{BEQ} = 0.7V$

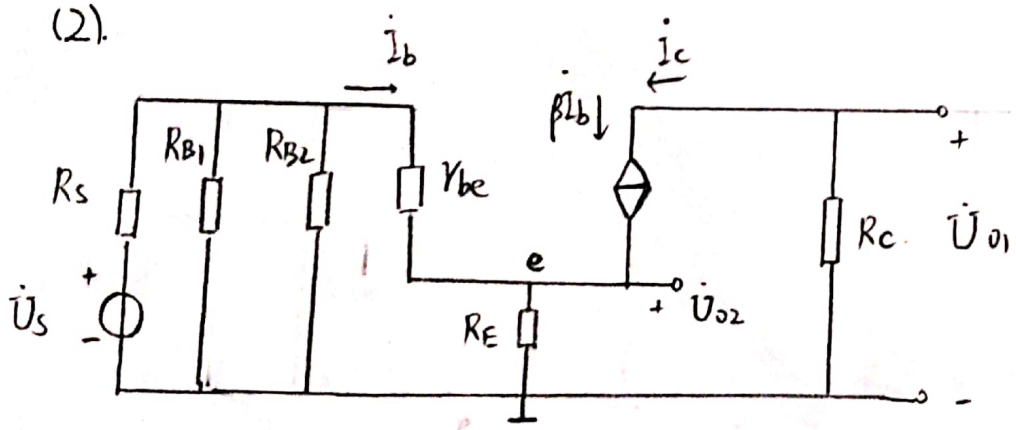
$\therefore U_B \approx \frac{R_{B2}}{R_{B1}+R_{B2}} V_{cc} = 4.286V$

$I_{CQ} \approx I_{EQ} = \frac{U_B - U_{BEQ}}{R_E} \approx \frac{U_B}{R_E}$ ~~$= 2.143mA$~~

$= 1.79\ mA$

$U_{CEQ} = V_{cc} - I_{CQ}(R_C + R_E) = 2.83V$

(2).



$r_{be} = r_{bb'} + (1+\beta)\frac{26mV}{I_{EQ}} = 1186\Omega$

$R_i' = r_{be} + (1+\beta)R_E = 12.3k\Omega$

$R_i = R_{B1} // R_{B2} // R_i' = 8013.8\Omega$

$\dot{U}_s = \dot{U}_i + \dot{U}_{RS} = \dot{I}_b R_i' + \frac{\dot{I}_b R_i'}{R_i} \cdot R_S = \dot{I}_b R_i'(1 + \frac{R_S}{R_i})$

$\dot{U}_{o1} = -\dot{I}_c R_c = -\beta \dot{I}_b R_c$

$\therefore A_{u1} = \frac{\dot{U}_{o1}}{\dot{U}_s} = -\frac{\beta R_c}{R_i'(1+\frac{R_S}{R_i})} = -0.78$

联系方式：

$$\dot{U}_{O2} = (1+\beta)\dot{I}_b R_E$$

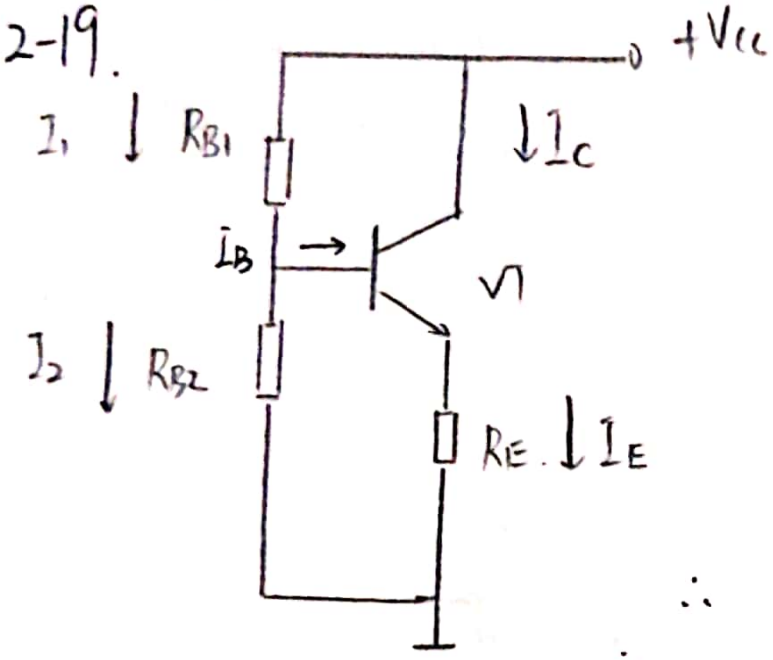
$$\therefore A_{U_2} = \frac{\dot{U}_{O2}}{\dot{U}_S} = \frac{(1+\beta)R_E}{R_i'\left(1+\frac{R_S}{R_i}\right)} = -0.793$$

(3) 由(2)知 $R_i = R_{B1} // R_{B2} // R_i' = 8.01\ k\Omega$

$$R_{O1} = R_c = 2k\Omega$$

$$R_{O2} = R_E // \frac{r_{be} + (R_S // R_{B1} // R_{B2})}{1+\beta} = 45\ \Omega$$

2-19.



(1)

$I_1 \gg I_B$

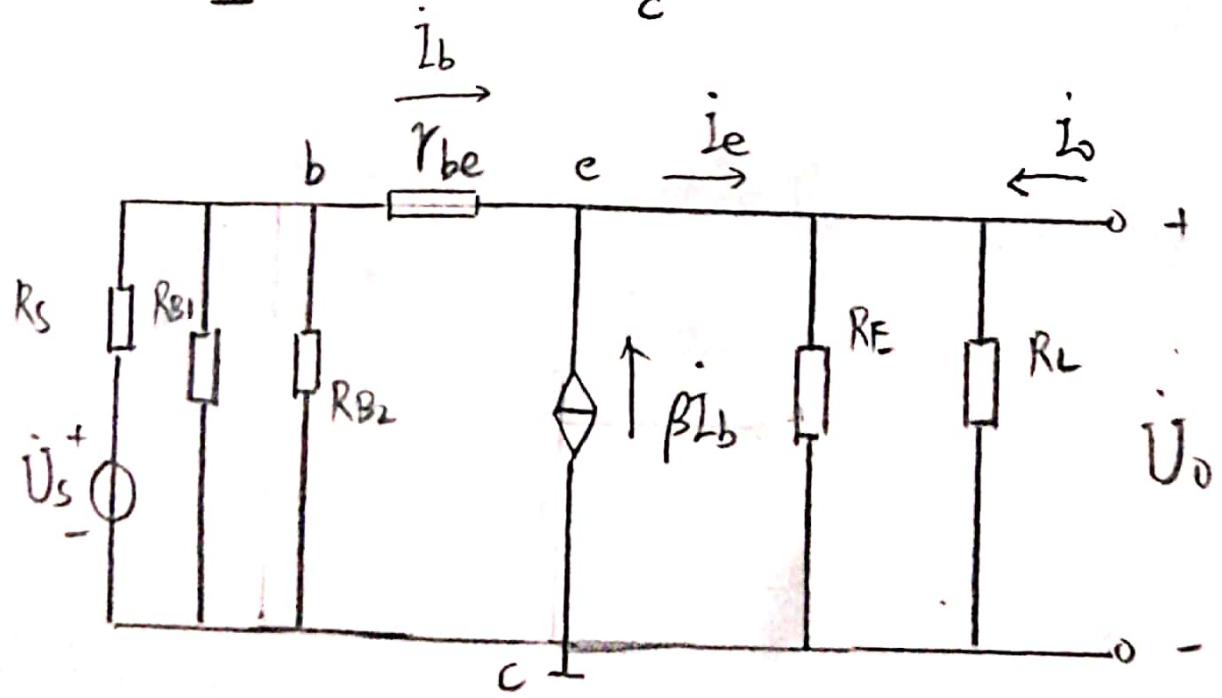
$I_1 \approx I_2$

$$\therefore U_B \approx \frac{R_{B2}}{R_{B1}+R_{B2}} V_{CC} = 4.15\,V$$

$$I_{CQ} \approx I_{EQ} = \frac{U_B - U_{BEQ}}{R_E} \approx \frac{U_B}{R_E} = 2.07\,mA$$

$$\therefore U_{CEQ} = V_{CC} - I_{EQ} R_E = (12 - 2.07 \times 2)\,V = 7.85\,V$$

(2)



$$A_u = \frac{\dot{U}_o}{\dot{U}_i} \qquad \dot{U}_o = \dot{I}_e (R_E // R_L) = (1+\beta)\dot{I}_b (R_E // R_L)$$

$$\dot{U}_i = \dot{I}_b r_{be} + \dot{U}_o = \dot{I}_b [r_{be} + (1+\beta)(R_E // R_L)]$$

$$\therefore A_u = \frac{(1+\beta)(R_E // R_L)}{r_{be} + (1+\beta)(R_E // R_L)} \qquad R_E // R_L = 1\,k\Omega$$

$$r_{be} = r_{bb'} + (1+\beta)\frac{26mV}{I_{EQ}} = 1.37\,k\Omega$$

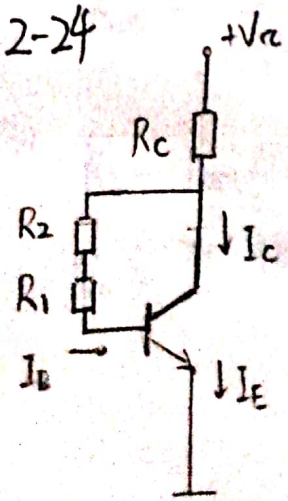
$$\therefore A_u = 0.987$$

$$R_i = \frac{\dot{U}_i}{\dot{I}_i} = \frac{\dot{U}_i}{\dot{U}_i/(R_{B1} // R_{B2}) + \dot{I}_b} = \frac{r_{be} + (1+\beta)(R_E // R_L)}{\frac{r_{be} + (1+\beta)(R_E // R_L)}{R_{B1} // R_{B2}} + 1} = 21.86\,k\Omega$$

$$R_o = \frac{\dot{U}_o}{\dot{I}_o} = \frac{\dot{U}_o}{\dot{U}_o/R_E + (1+\beta)\frac{\dot{U}_o}{r_{be} + (R_S // R_{B1} // R_{B2})}} = R_E // \frac{r_{be} + (R_S // R_{B1} // R_{B2})}{1+\beta}$$

$$= 22.9\,\Omega$$

2-24



$$V_{CC} = (I_C + I_B)R_C + U_{CEQ} \qquad \therefore I_B = 0.026\,mA$$

$$I_C = \beta I_B$$

$$U_{BEQ} = V_{CC} - (I_C + I_B)R_C - I_B(R_1 + R_2)$$

$$\therefore R_1 = R_2 = 62.73\,k\Omega$$

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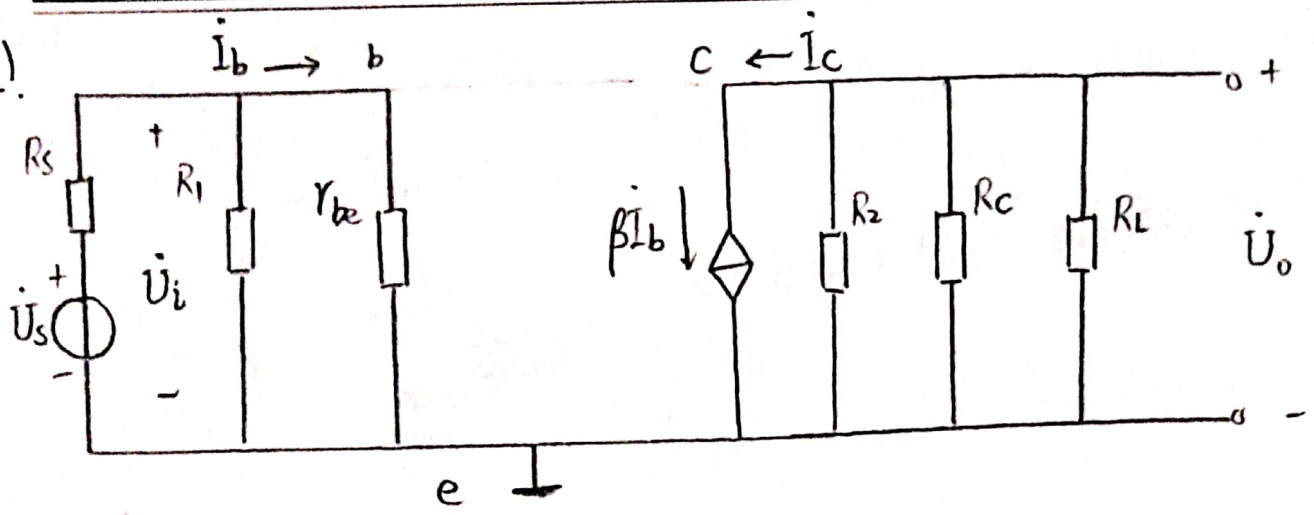
(2)



$$I_{EQ} = \beta I_B = 0.0263\,mA \times 50 = 1.32mA$$

$$r_{be} = r_{bb'} + (1+\beta)\frac{26mV}{I_{EQ}} = 1.31\,k\Omega$$

$$\dot{U}_o = -\dot{I}_c(R_2 /\!/ R_C /\!/ R_L) = -\beta\dot{I}_b(R_2 /\!/ R_C /\!/ R_L)$$

$$\dot{U}_i = \dot{I}_b r_{be}$$

$$\therefore \dot{A}_u = \frac{\dot{U}_o}{\dot{U}_i} = -\frac{\beta(R_2 /\!/ R_C /\!/ R_L)}{r_{be}} = -148$$

$$\dot{U}_S = \dot{I}_b r_{be} + \frac{\dot{I}_b r_{be}}{R_1 /\!/ r_{be}} \cdot R_S = \dot{I}_b r_{be}\left(1 + \frac{R_S}{R_1 /\!/ r_{be}}\right)$$

$$\therefore \dot{A}_{us} = \frac{\dot{U}_o}{\dot{U}_S} = -\frac{\beta(R_2 /\!/ R_C /\!/ R_L)}{r_{be}\left(1 + \frac{R_S}{R_1 /\!/ r_{be}}\right)} = -83$$

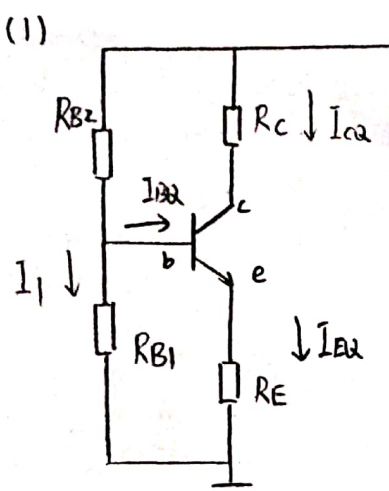
(3)

$$R_i = r_{be} /\!/ R_1 = 1.27\,k\Omega$$

$$R_o = R_2 /\!/ R_C = 7.25\,k\Omega$$

2-25.

(1)



$I_{CQ} = 1mA \quad \therefore I_{BQ} = \frac{I_{CQ}}{\beta} = 0.01mA$

$\therefore I_1 \approx 10 I_{BQ} = 0.1mA \quad U_{BQ} = 3.5V$

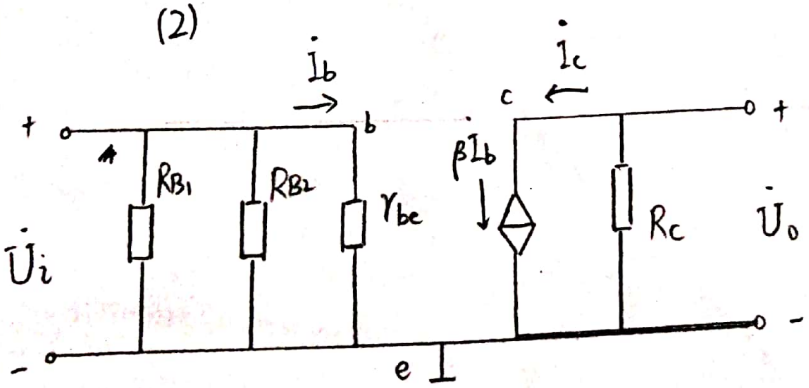
$U_{BQ} = I_1 R_{B1} \Rightarrow R_{B1} = 35k\Omega$

$V_{CC} - U_{BQ} = (I_1 + I_{BQ}) \cdot R_{B2} \Rightarrow R_{B2} = 77.3k\Omega$

$$\begin{cases} U_{BQ} - U_{BEQ} = I_{EQ} R_E \Rightarrow R_E = 2.8k\Omega \\ I_{EQ} \approx I_{CQ} \end{cases}$$

$V_{CC} - I_{CQ}R_C - I_{EQ}R_E = U_{CEQ} \Rightarrow R_C =$ ~~5.2kΩ~~ ~~5.3kΩ~~ 5.2 kΩ

(2)



$\dot{U}_o = -\dot{I}_c R_c = -\beta \dot{I}_b R_c$

$\dot{U}_i = \dot{I}_b r_{be}$

$\therefore A_u = \frac{\dot{U}_o}{\dot{U}_i} = -\frac{\beta R_c}{r_{be}} = -192.6$

$R_i = R_{B1} // R_{B2} // r_{be} = 2.43k\Omega$

$R_o = R_c = 5.2k\Omega$