

作业纸

课程名称: 模电

第二章

教学班级: 1907

姓名: 胡文宇

学号: 1120193164

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- 2-1. 1. a、b ; a、a 2. b 五. a、b
4. a、a、b 5. b

2-1b 1. 由 $A_u = \frac{-\beta(R_L \parallel R_L)}{r_{be} + (1+\beta)R_E}$, $R_i = R_{B1} \parallel R_{B2} \parallel [r_{be} + (1+\beta)R_E]$
则当 β 增大, A_u 会略微减小, R_i 会略微增大 (基本不变).

2. 当 R_E 增大, A_u 会减小, R_i 会增大.

2-4. A管: X: 发射极 Y: 基极 Z: 集电极 PNP型

B管: X: 基极 Y: ~~发射极~~ 集电极 Z: 发射极 NPN型

2-7. a): 不能 PNP型晶体管应有 $U_c > U_b > U_e$, 不能正常放大.
应将 $+V_{cc}$ 改为 $-V_{cc}$

b): 不能 发射结为零偏置, 不能正常放大
应将电阻 R_B 接到 V_{cc}

c): 不能 不满足晶体管所需的电压条件
应接基极与 V_{cc} 间加 R_B

d): 不能 无基极偏置电流
将 R_B 断开并接至 $+V_{cc}$

e): 可以正常放大 f): 可以正常放大

g): 不能 输出对地短路
应在集电极加 R_c

h): 不能 基极对地短路, 输入无法进入晶体管输入端
~~基极~~ 基极对地短路 C_b .

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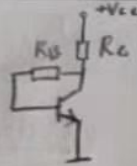
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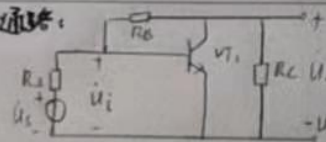
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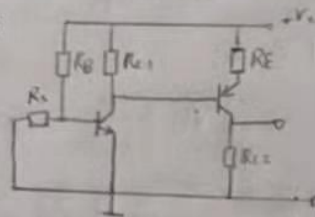
2-8. a): 直流通路:



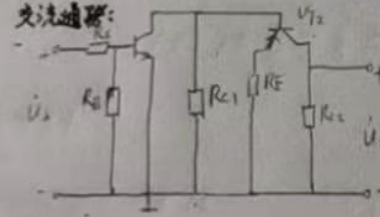
交流通路:



b): 直流通路:

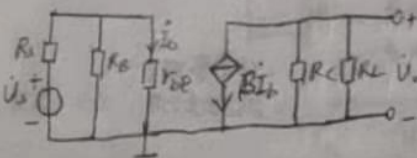


交流通路:



2-14. 1. 由 $I_{BQ} = \frac{I_{CQ}}{\beta} = 10\mu A$, $R_B = \frac{V_{CC} - V_{BEQ}}{I_{BQ}} = 1.13M\Omega$

2. 等效电路:



$$r_{be} = r_{bb'} + (1 + \beta) \frac{26mV}{I_{EQ}} = 2700\Omega$$

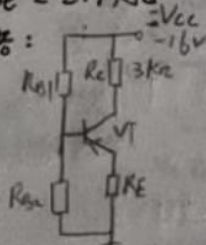
$$2. A_u = \frac{U_o}{U_i} = \frac{-\beta I_b R_L'}{r_{be} I_b} = -112$$

$$A_{us} = \frac{R_B // r_{be}}{R_B // r_{be} + R_s} \cdot A_u = -83$$

3. $R_i = R_B // r_{be} = 2.7k\Omega$

$R_o = R_C = 16k\Omega$

2-15. 1). 直流通路:



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

$$I_{BQ} = \frac{U_B + 0.3}{R_E} = -1.85mA$$

$$I_{CQ} = \frac{I_{CQ}}{\beta} = -0.03mA$$

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

2) 要 $U_{CEQ} = -4V$, 则 $I_{CQ} = \frac{-V_{CC} - U_{CEQ}}{R_C + R_E} = -2.4mA$ $U_{BQ} = I_{CQ} R_E - 0.3 = -5.1V$

$$U_B = \frac{R_{B2}}{R_{B1} + R_{B2}} (-V_{CC}) \Rightarrow R_{B1} = 47k\Omega$$

联系方式:

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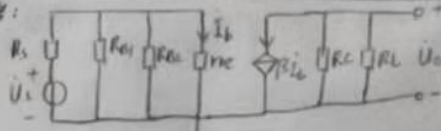
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3) 微变等效电路:



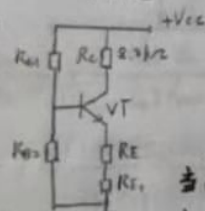
$$r_{be} = r_{bb'} + (1+\beta) \frac{26\text{mV}}{I_{EQ}} \approx 1.3\text{k}\Omega$$

$$R_i = R_{B1} // R_{B2} // r_{be} = 1.2\text{k}\Omega$$

$$R_o = R_C = 3\text{k}\Omega$$

$$A_{us} = \frac{U_o}{U_s} = - \frac{R_i}{R_i + R_s} \cdot \frac{\beta(R_C // R_L)}{r_{be}} = -55$$

2-17. 直流通路:



$$U_{BQ} = \frac{R_{B2}}{R_{B1} + R_{B2}} V_{CC} = 2.12\text{V}$$

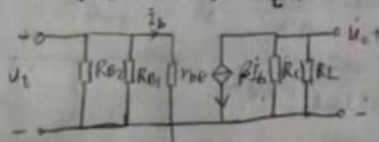
$$I_{EQ} = \frac{U_{BQ} - U_{BEQ}}{R_E + R_{E1}}$$

$$\text{当 } R_E = 0, I_{EQ} = 1.42\text{mA}$$

$$\text{当 } R_E = 200\Omega, I_{EQ} = 1.18\text{mA}$$

微变等效:

① 当 $R_E = 0$, 交流通路:



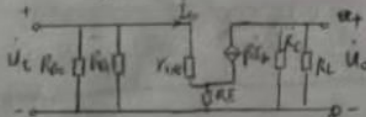
$$\text{则 } R_o = R_C = 8.2\text{k}\Omega; R_i = R_{B2} // R_{B1} // r_{be}, r_{be} = 100\Omega + (1+100) \frac{26\text{mV}}{1.42\text{mA}} = 1.949\text{k}\Omega$$

$$\text{则 } R_i \approx 1.6\text{k}\Omega$$

$$A_u = \frac{-\beta I_b (R_C // R_L)}{I_b \cdot r_{be}} \approx -181$$

微变等效:

② 当 $R_E = 200\Omega$, 交流通路:



$$R_o = R_C = 8.2\text{k}\Omega$$

$$r_{be} = 100\Omega + 1.949\text{k}\Omega, r_{be} = 100\Omega + (1+100) \frac{26\text{mV}}{1.18\text{mA}} = 2.325\text{k}\Omega$$

$$R_i = R_{B2} // R_{B1} // (r_{be} + (1+\beta)R_E) = 6.33\text{k}\Omega$$

$$A_u = - \frac{\beta I_b (R_C // R_L)}{I_b [r_{be} + (1+\beta)R_E]} = -15.8$$

当 R_E 增大, 输入电压 R_i 会增大, 电压增益 A_u 会减小.

联系方式:

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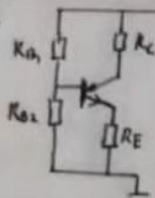
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2-18 1. 直流通路:



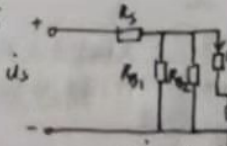
$$U_{BQ} = \frac{R_{B2}}{R_{B1} + R_{B2}} \cdot V_{CC} = 4.29 \text{ V}$$

$$I_{CQ} = \frac{U_{BQ} - U_{BEQ}}{R_E} = 1.3 \text{ mA}$$

$$U_{CEQ} = V_{CC} - I_{CQ} \cdot (R_C + R_E) = 4.8 \text{ V}$$

微变等效:

2. 交流通路:



$$r_{be} = r_{bb'} + (1 + \beta) \frac{26 \text{ mV}}{I_{CQ}} \approx 2 \text{ k}\Omega$$

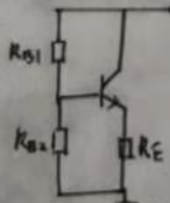
$$R_i = R_{B1} // R_{B2} // (r_{be} + (1 + \beta) R_E) = 6 \text{ k}\Omega$$

$$A_{u1} = \frac{U_{o1}}{U_s} = - \frac{\beta I_b \cdot R_c}{I_b (r_{be} + (1 + \beta) R_E)} \cdot \frac{R_i}{R_i + R_s} = -0.75$$

$$A_{u2} = \frac{U_{o2}}{U_s} = - \frac{(1 + \beta) I_b \cdot R_E}{I_b (r_{be} + (1 + \beta) R_E)} \cdot \frac{R_i}{R_i + R_s} = -0.75$$

$$R_{o1} = R_c = 2 \text{ k}\Omega, \quad R_{o2} = R_E // \frac{r_{be} + R_{B1} // R_{B2} // R_s}{1 + \beta} \approx 36 \Omega$$

2-19 1. 直流通路:

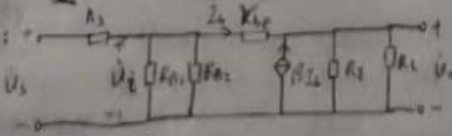


$$U_{BQ} = \frac{R_{B2}}{R_{B1} + R_{B2}} \cdot V_{CC} = 4.9 \text{ V}$$

$$I_{CQ} = \frac{U_{BQ} - U_{BEQ}}{R_E} = 2.1 \text{ mA}$$

$$U_{CEQ} = V_{CC} - I_{CQ} \cdot R_C = 7.8 \text{ V}$$

2. 交流通路: 微变等效:



$$r_{be} = r_{bb'} + (1 + \beta) \frac{26 \text{ mV}}{I_{CQ}} = 1350 \Omega$$

$$A_u = \frac{U_o}{U_s} = \frac{(1 + \beta) (R_E // R_L)}{r_{be} + (1 + \beta) (R_E // R_L)} \approx 0.987$$

$$R_o = R_E // R_L = 1 \text{ k}\Omega$$

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

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

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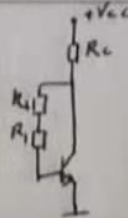
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2-24. 1. 直流通路:



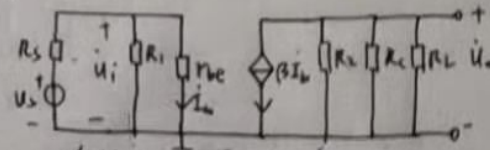
$$U_{CE} = V_{CC} - U_{CEQ} = 14V - 8V = 6V$$

$$\frac{V_{CC} - U_{CEQ}}{R_C} = (1 + \beta) \frac{U_{CEQ} - U_{BEQ}}{2R_1}$$

$$\Rightarrow R_1 = R_2 = 62.7k\Omega$$

2. $I_{EQ} = 1.34mA$

2. 微变等效电路:



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

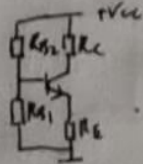
$$A_u = - \frac{\beta I_b (R_C \parallel R_L)}{I_b \cdot r_{be}} = -148$$

$$\text{由 } R_i = R_1 \parallel r_{be} = 1.3k\Omega, \text{ 则 } A_{us} = \frac{R_i}{R_i + R_s} A_u = -84$$

3. 由 2 得 $R_i = 1.3k\Omega$

$$R_o = R_C \parallel R_L = 7.3k\Omega$$

2-25. 1. 直流通路:



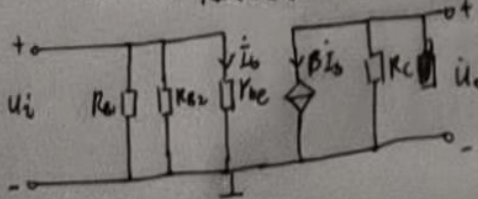
$$\text{由 } I_{CQ} \cdot (R_C + R_E) = V_{CC} - U_{CEQ}$$

$$U_{BQ} = \frac{R_{B1}}{R_{B1} + R_{B2}} \cdot V_{CC} = 3.5V$$

$$U_{EQ} = U_{BQ} - U_{BEQ} = 2.8V$$

$$\Rightarrow R_C = 5.2k\Omega, R_E = 2.8k\Omega, R_{B1} = 35k\Omega, R_{B2} = 85k\Omega$$

2. r_{be} 微变等效电路:



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

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

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

联系方式: