

2.4, $R_L = \infty$ 时,

$$I_{BQ} = \frac{V_{BB} - U_{BEQ}}{R_b} = 0.02 \text{ mA} = 20 \mu\text{A}$$

$$I_{CQ} = 2 \text{ mA}, U_{CEQ} = V_{CC} - R_c \cdot I_{CQ} = 6 \text{ V}$$

$\therefore Q_1$ 在 $U_{CE} = 6 \text{ V}$, $i_c = 2 \text{ mA}$ 处

$$U_{om} = \frac{1}{\sqrt{2}} \min \left(V_{CC} - U_{CEQ}, U_{CEQ} - U_{CES} \right) = 3.7 \text{ V}$$

$R_L = 3 \text{ k}\Omega$ 时

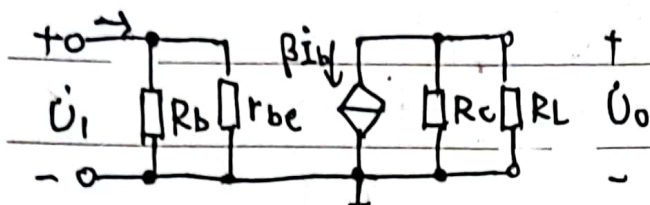
$$I_{BQ} = 20 \mu\text{A}, I'_{CQ} = 2 \text{ mA}$$

$$\text{设过 } R_L \text{ 电流 } I, \text{ 则 } \begin{cases} \frac{12 - U_{CEQ}}{3} = 2 + I \\ 3I = U_{CEQ} \end{cases} \Rightarrow \begin{cases} U_{CEQ} = 3 \text{ V} \\ I = 1 \text{ mA} \end{cases}$$

$\therefore Q_2$ 在 $U_{CE} = 3 \text{ V}$, $i_c = 2 \text{ mA}$ 处

$$U_{om} = \frac{1}{\sqrt{2}} \times 2.3 = 1.6 \text{ V}$$

2.5 $U_{BEQ} = 0.7V$, $U_{CEQ} = 4V$, $I_{BQ} = 20\mu A$,



$$A_u = \frac{U_o}{U_i} = -\frac{\beta I_b \cdot (R_c // R_L)}{I_b (R_b // r_{be})} = -\frac{\beta (R_c // R_L)}{r_{be}} = -\frac{80 \times 2.5}{1} = -200$$

$$R_i = R_b // r_{be} \approx 1k\Omega, R_o = R_c = 5k\Omega$$

$$U_s \approx U_i \cdot \frac{r_{be} R_s}{r_{be}} = 60mV$$

\therefore (1) \times (2) \times (3) \times (4) \checkmark (5) \times (6) \times (7) \times (8) \checkmark
(9) \checkmark (10) \times (11) \times (12) \checkmark

2.7 $R_L = \infty$ 时

$$U_{BEQ} = 0.7V$$

$$I_{BQ} = \frac{V_{CC} - U_{BEQ}}{R_b} = \frac{U_{BEQ}}{R_s} = 0.022mA$$

$$I_{CQ} = \beta I_{BQ} = 1.76mA$$

$$U_{CEQ} = V_{CC} - I_{CQ} \cdot R_c = 6.2V \quad \therefore Q \text{ 点 } U_{CE} = 6.2V, I_C = 1.76mA$$

$$U_o = -\frac{\beta I_b \cdot R_c}{I_b (R_b // r_{be})}, \text{ 其中 } r_{be} \approx r_{bb'} + \beta \frac{U_T}{I_{CQ}} = 1282\Omega$$

$$\therefore U_o = -3/2, R_i = 1282\Omega, R_o = 5k\Omega$$

$R_L = 3k\Omega$ 时

$$U_{BEQ} = 0.7V, I_{BQ} = 0.022mA, I_{CQ} = 1.76mA$$

$$U_{CEQ} = 15 \cdot \frac{3}{8} - I_{CQ} \cdot (R_c // R_L) = 2.3V$$

$\therefore Q$ 点在 $I_C = 1.76mA, U_{CE} = 2.3V$ 处

$$\dot{A}_u = - \frac{\beta \dot{I}_b (R_c // R_L)}{\dot{I}_b \cdot r_{be}} = -117$$

$$R_i = 1282 \Omega \cdot R_o = 5 k\Omega$$

$$2.9(1) I_{CQ} = (V_{CC} - U_{CEQ}) \cdot \frac{1}{R_c} = 2 \text{ mA}$$

$$I_{BQ} = \frac{I_{CQ}}{\beta} = 0.02 \text{ mA}$$

$$R_b = \frac{V_{CC} - U_{BEQ}}{I_{BQ}} = 565 k\Omega$$

$$(2) \frac{\beta(R_c // R_L)}{r_{be}} = 220, \quad \frac{1}{5} + \frac{1}{R_c} = \frac{1}{2.2}, \quad R_c = 3.9 k\Omega$$

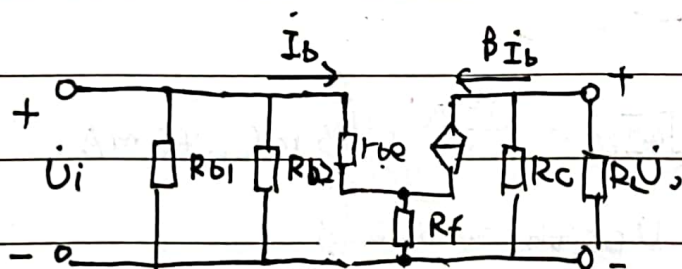
$$\frac{1.3}{1282 \Omega}$$

$$2.11(1) I_1 \gg I_{BQ}, \quad U_{BQ} \approx \frac{R_{b1}}{R_{b1} + R_{b2}} \cdot V_{CC} = 2 \text{ V}$$

$$I_{EQ} = \frac{U_{BQ} - U_{BEQ}}{R_f + R_e} = 1 \text{ mA}, \quad I_{BQ} = \frac{I_{EQ}}{1 + \beta} \approx 0.01 \text{ mA}$$

$$U_{CEQ} = V_{CC} - I_{CQ} R_c - I_{EQ} (R_f + R_e) \approx 5.7 \text{ V}$$

∴ Q 点在 $U_{CE} = 5.7 \text{ V}$, $I_c = 1 \text{ mA}$ 处



$$100 + 100 \cdot \frac{2600}{0.011 \text{ mA}}$$

$$r_{be} = r_{bb'} + \beta \frac{U_T}{I_{CQ}} = 2.7 k\Omega$$

$$\dot{A}_u = \frac{\beta(R_c // R_L)}{r_{be} + (1 + \beta)R_f} \approx -7.6$$

$$R_i = R_{b1} // R_{b2} // (r_{be} + (1 + \beta)R_f) = 3.7 k\Omega$$

$$R_o = R_c = 5 k\Omega$$

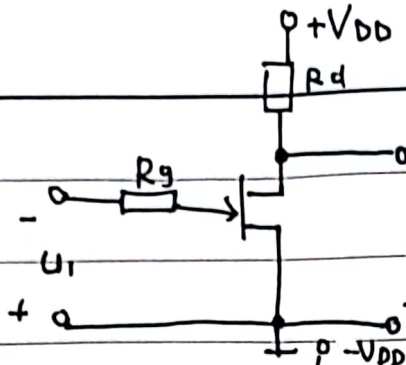
$$(2) I'_{EQ} = I_{EQ} = 1 \text{ mA}, \quad I'_{BQ} = \frac{I'_{EQ}}{1 + \beta} = 0.005 \text{ mA}$$

$$U_{CEQ} = V_{CC} - I_{CQ} R_c - I'_{EQ} (R_f + R_e) \approx 5.7 \text{ V}, \quad \text{Q 点 } U_{CE} \text{ 不变, } I_B \text{ 变为 } 0.005 \text{ mA}$$

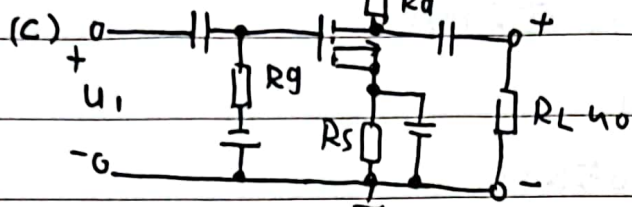
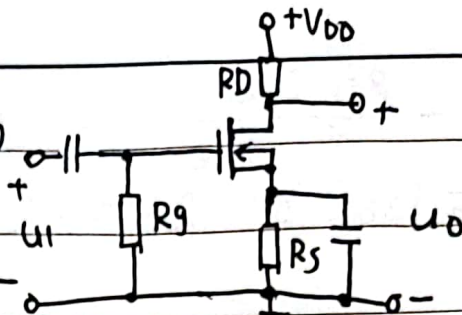
$$(3) \dot{A}'_u = - \frac{\beta(R_c // R_L)}{r_{be} + (1 + \beta)(R_f + R_o)}, \quad \text{变小}$$

$$R'_i = R_{b1} // R_{b2} // (r_{be} + (1 + \beta)(R_f + R_e)), \quad \text{变大}$$

2.14. (a)



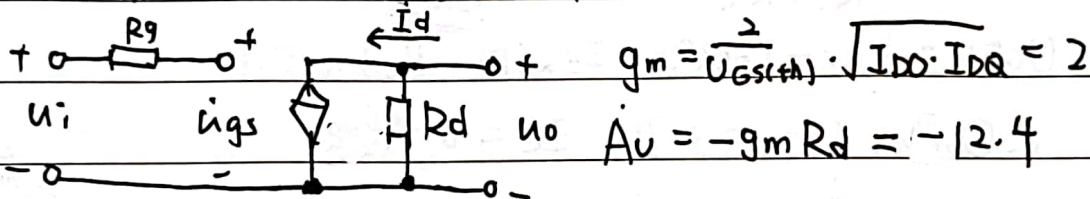
(b)



2-16. (1) $U_{GSQ} = V_{GG} = 3V$, $I_{DQ} = 4mA$, $U_{GS(th)} = 2V$

$$I_{DQ} = I_{DQ} \left(\frac{U_{GS}}{U_{GS(th)}} - 1 \right)^2 = 1mA, U_{DSQ} = V_{DD} - I_{DQ} \cdot R_d = 8.8V$$

$\therefore Q$ 点在 $U_{DS} = 8.8V$, $I_D = 1mA$ 处



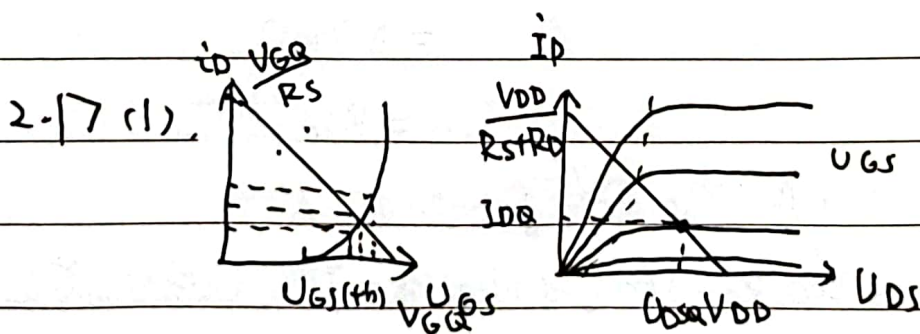
$$g_m = \frac{2}{U_{GS(th)}} \cdot \sqrt{I_{DQ} \cdot I_{DQ}} = 2$$

$$A_v = -g_m R_d = -12.4$$

(2) $A_v \rightarrow -15$, $g_m = \sqrt{4I_{DQ}} = \frac{15}{6.2}$, $I_{DQ} \approx 1.46mA$

$$U_{GSQ} = \left(\sqrt{\frac{I_{DQ}}{I_{DQ}}} + 1 \right) \cdot U_{GS(th)} = 3.2V$$

U_{GSQ} 增大至 $3.2V$



底部: 减小 R_2 / 增大 R_1 / 增大 R_S / 减小 R_d

顶部: 减小 R_S / 增大 R_2 / 减小 R_1 /

$$(2) \dot{A}_v = -g_m(R_D // R_L) \quad V_{GS} \uparrow$$

$$g_m = \frac{2}{U_{GS(th)}} \sqrt{I_{DQ} \left(\frac{U_{GSQ}}{U_{GS(th)}} - 1 \right)^2}$$

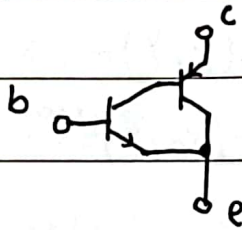
可增大 R_D / R_L , 减小 R_S , 增大 R_2 , 减小 R_1 , 增大 V_{DD}

$$R_i = R_3 + (R_1 // R_2), \text{ 可增大 } R_1, R_2, R_3$$

2-18. (a) 不行

(b) 不行

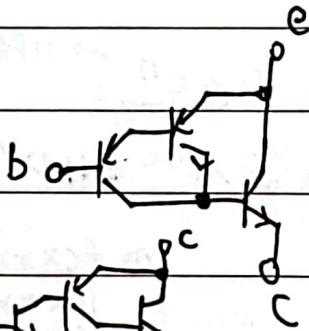
(c) 行, NPN



(d) 不行

(e) 不行

(f) 行, PNP



(g) 行, NPN

