

# 國立臺灣科技大學答案卷

National Taiwan University of Science and Technology Answer Sheet

姓名/Name 張恒豪

學號/Student ID B11002110

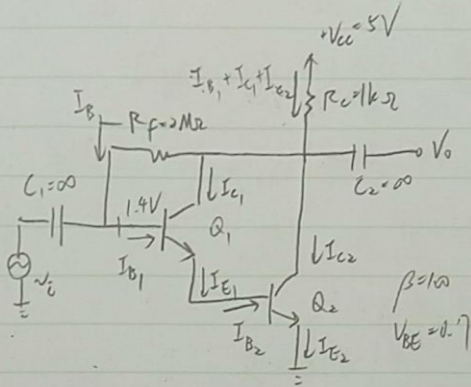
班級/Class 四電子二乙

科目/Course title 電子學

日期/Date 11.12.13

評分 Score	教師簽章 Signature of Lecturer

錯太多，乾脆直接重寫，重寫pdf在同一資料夾中



$$r_{\pi 1} = \frac{V_T}{I_{BQ1}} \approx 88.1k$$

$$r_{\pi 2} = \frac{V_T}{I_{BQ2}} \approx 872\Omega$$

$$5 - 1k \cdot (I_{B1} + I_{C1} + I_{C2}) - 2M \cdot (I_{B1}) = 1.4$$

$$I_{C1} = \beta I_{B1}$$

$$I_{C2} = \beta I_{B2} = \beta (1 + \beta) I_{B1}$$

$$\Rightarrow 5 - 1k (I_{B1} + \beta I_{B1} + \beta (1 + \beta) I_{B1}) - 2M (I_{B1}) = 1.4$$

$$\Rightarrow 5 - 1k I_{B1} - 10k I_{B1} - 10100k I_{B1} - 2M I_{B1} = 1.4$$

$$\Rightarrow I_{B1} \approx 0.295 \mu A$$

$$\Rightarrow I_{B2} = (1 + \beta) I_{B1} \approx 29.8 \mu A$$

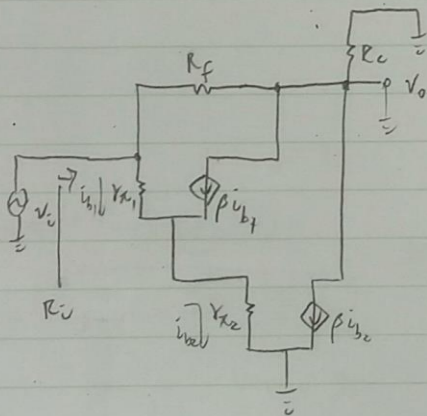
$$\Rightarrow I_{C1} = \beta I_{B1} \approx 29.5 \mu A$$

$$\Rightarrow I_{C2} = \beta I_{B2} \approx 2.98 mA$$

$$\Rightarrow I_{E1} = (1 + \beta) I_{B1} \approx 29.8 \mu A$$

$$I_{E2} = (1 + \beta) I_{B2} \approx 3.01 mA$$

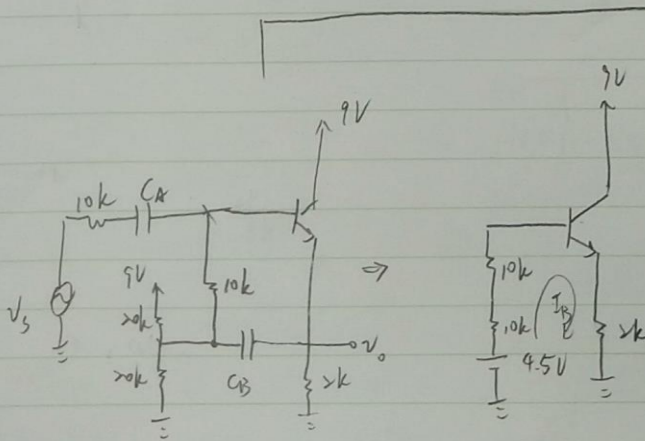
#1(a)



$$\frac{v_o}{v_i} = \left[ \frac{100}{88.1k + 101 \cdot 872} + 1 \right] \cdot 100 + \frac{100}{88.1k + 101 \cdot 872} \cdot 1000 \cdot (-1)$$

$$\approx 10^6 \frac{V}{V} \quad \#1(b)$$

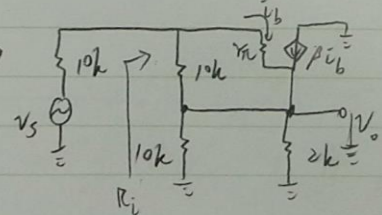
$$R_i = (r_{\pi 1} + (1 + \beta) r_{\pi 2}) \parallel R_f \approx 176k \parallel 2M \approx 162k\Omega \quad \#1(c)$$



β = 100

$$I_{B1} = \frac{4.5 - 0.7}{20k + 20k} \approx 17.3 \mu A$$

$$r_{\pi 1} = \frac{V_T}{I_{BQ1}} \approx 1.5k\Omega$$



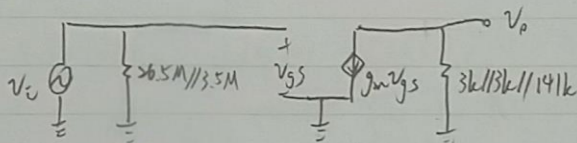
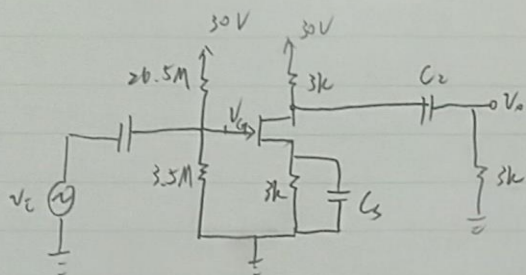
$$R_i = 10k \parallel r_{\pi 1} \approx 1.35k\Omega \quad \#2(b)$$

$$\frac{v_o}{v_s} = \frac{1.35k}{10k + 1.35k} \cdot \frac{1}{1.35k + 2k \cdot 100} \cdot 100 \cdot 2k$$

$$\approx 0.12 \frac{V}{V} \quad \#2(a)$$

可轉頁再寫。

3



$$V_{GS} = 30 \cdot \frac{3.5}{20.5 + 3.5} = 3.5V$$

$$I_D = 12m \left( 1 + \frac{V_{GS}}{5} \right)^2$$

$$V_{GS} = 3.5 - I_D \cdot 3k \Rightarrow I_D = \frac{3.5 - V_{GS}}{3k}$$

$$\frac{3.5 - V_{GS}}{3k} = 12m \left( 1 + \frac{2}{5} V_{GS} + \frac{V_{GS}^2}{25} \right)$$

$$\Rightarrow \frac{12}{25} V_{GS}^2 + \left( \frac{24}{5} + \frac{1}{3} \right) V_{GS} + \left( 12 - \frac{3.5}{3} \right) = 0$$

$$\Rightarrow V_{GS} = -2.89 \text{ or } -7.80$$

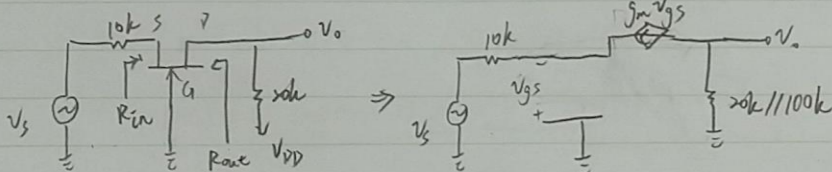
$$\Rightarrow I_D = 2.13 \text{ mA}$$

$$V_{GS} = -2.89V \quad \#3(a)$$

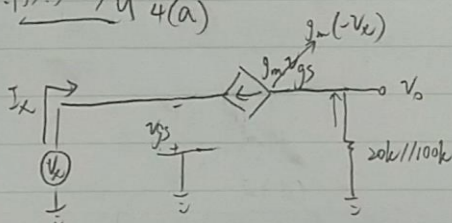
$$r_o = \frac{V_A}{I_{DQ}} = 141k\Omega \quad g_m = 2\sqrt{k_n I_{DQ}}$$

$$\frac{V_o}{V_i} = -g_m \cdot (3k // 3k // 141k) =$$

4.



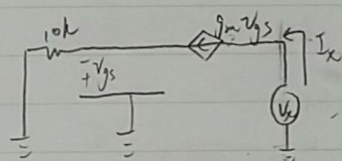
$$\frac{V_o}{V_i} = (-1)(-g_m) \cdot (20k // 100k) = 33.3 \text{ V/V} \quad \#4(a)$$



$$\text{設 } V_x = 10V$$

$$I_x = -2m \cdot (-10) = 20m$$

$$R_{in} = \frac{V_x}{I_x} = \frac{10}{20 \cdot m} = 500\Omega \quad \#4(b)$$

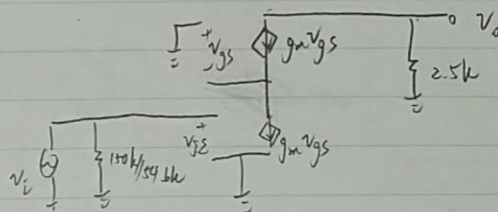
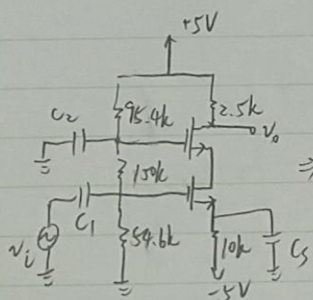


$$\text{設 } V_x = 10V$$

$$g_m V_{GS} = I_x$$

$$V_{GS} = -I_x \cdot 10k$$

5.



$$I_D = 0.4 \text{ mA}$$

$$k_n = 0.8 \text{ mA/V}^2$$

$$\frac{V_o}{V_i} = -g_m \cdot 2.5k = -2.83 \quad \#5$$

$$g_m = 2\sqrt{k_n I_{DQ}} = 1.13 \text{ mA/V}$$



# 國立臺灣科技大學答案卷

National Taiwan University of Science and Technology Answer Sheet

姓名/Name 張恒豪

學號/Student ID B11002110

班級/Class 四電子二乙

科目/Course title 電子學

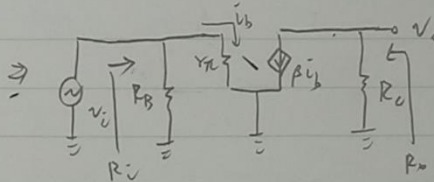
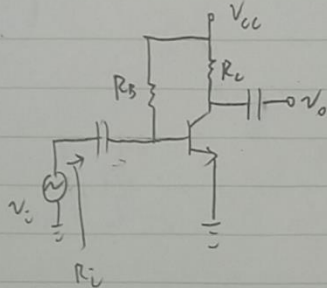
日期/Date 111.12.13

評分 Score	教師簽章 Signature of Lecturer

記分欄 從此處開始寫起。試卷用紙務須節用，非經主試認可不得續用其他紙張作答。/Please write from here.

6.

CE

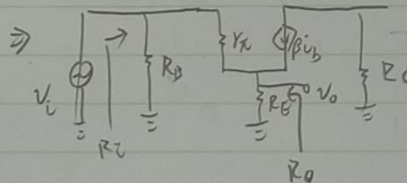
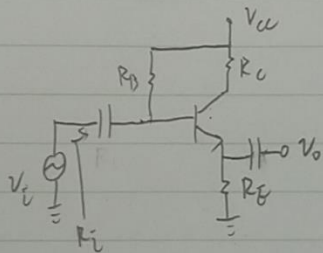


$$R_i = R_B // r_{\pi} \Rightarrow \text{中}$$

$$R_o = R_C \Rightarrow \text{中}$$

$$\frac{v_o}{v_i} = \frac{-1}{R_B // r_{\pi}} \beta \cdot R_C > 1 \Rightarrow \text{反相電壓放大}$$

CC



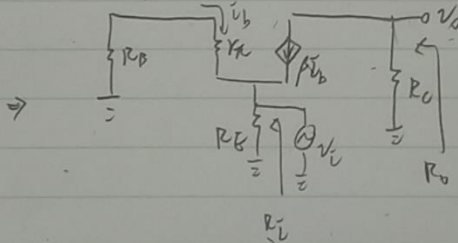
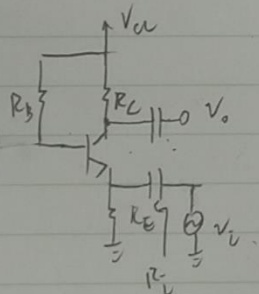
$$R_i = R_B // [r_{\pi} + (1+\beta)R_E] \Rightarrow \text{中}$$

$$R_o = R_E // \left[ \frac{r_{\pi}}{1+\beta} \right] \Rightarrow \text{小}$$

$$\frac{v_o}{v_i} = \frac{1}{r_{\pi} + (1+\beta)R_E} \beta \cdot R_E < 1$$

$$\frac{i_o}{i_i} = \frac{\frac{v_o}{R_E}}{\frac{v_i}{R_B}} > 1 \Rightarrow \text{電流放大}$$

CB



$$R_i = R_E // \left( \frac{r_{\pi}}{1+\beta} + \frac{R_B}{1+\beta} \right) \Rightarrow \text{大}$$

$$R_o = R_C \Rightarrow \text{中}$$

$$\frac{v_o}{v_i} = -\frac{r_{\pi}}{R_E} \beta \cdot R_C$$