考生注意事項：

一、考試時間 80 分鐘。

二、應考人不得自行攜帶電子計算器，一律由本校統一提供。

三、

試題一：〈20 分〉

Find the output voltage of the circuit shown in Fig. 1. (v_o expression in terms of v_1 and v_2)
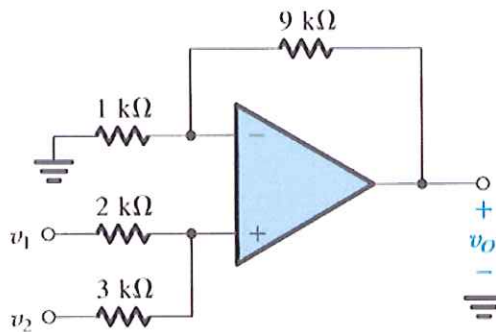

Fig. 1

試題二：〈20 分〉

Design the circuit in Fig. 2 to obtain a current I_D of 80 μA. Find the value required for R, and find the dc voltage V_D. Let the NMOS transistor have $V_t=0.6$ V, $\mu_n C_{ox}=200$ μA/V^2, $L=0.8$ μm, and $W=4$ μm. Neglect the channel-length modulation effect (i.e., assume $\lambda=0$)
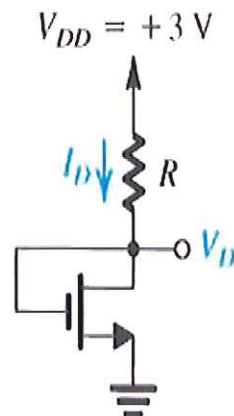

Fig. 2

試題三：〈20 分〉

Design the circuit in Fig. 3 to establish a drain voltage of 0.1 V. What is the current I_D and R_D ? What is the effective resistance between drain and source at this operating point? Let V_t=1 V, k_n'(W/L)=1 mA/V^2, k_n'=$\mu_n C_{ox}$
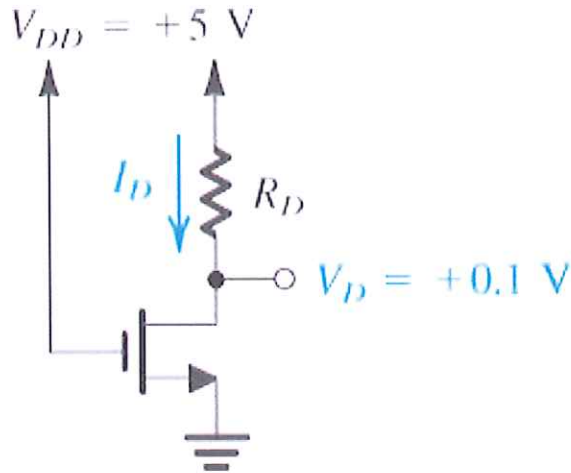

Fig. 3

試題四：〈20 分〉

We want to analyze the circuit of Fig. 4 to determine I_B, I_C, V_B, and V_C. Assume β=100, V_{BE}=0.7 V.

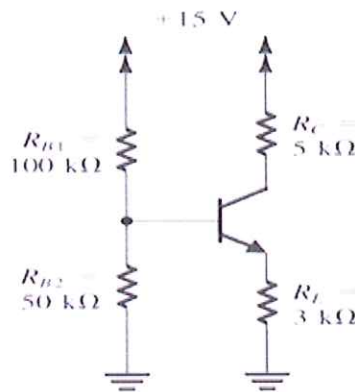Fig. 4

試題五：〈20 分〉

Consider the CMOS common-source amplifier in Fig. 5 for the case V_{DD}=3 V, V_{tn}=$|V_{tp}|$=0.6 V, $\mu_n C_{ox}$=200 μA/V^2, and $\mu_p C_{ox}$=65 μA/V^2. For all transistors, L=0.4 μm and W=4 μm. Also Early voltage of V_{An}=20 V for NMOS, $|V_{Ap}|$=10 V for PMOS, and I_{REF}=100 μA. Find the transconductance g_m and the small-signal voltage gain (v_o/v_i) of the common-source amplifier.
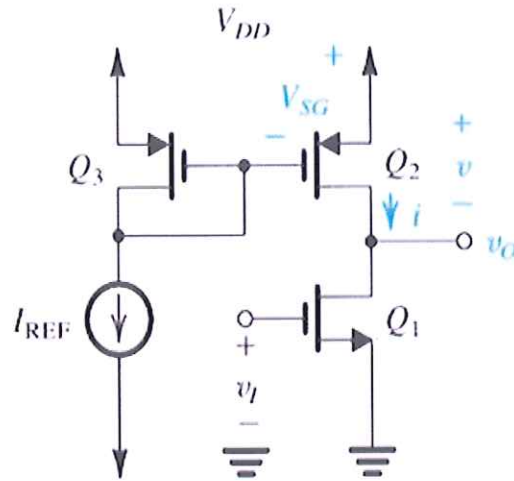
Fig. 5

試題六：〈40 分〉

The transistors in the circuit shown in Fig. 6 have parameters $V_{TND}=V_{TNL}=1V$, $K_{nD}=50\mu A/V^2$, and $K_{nL}=10\mu A/V^2$. Also assume $\lambda_{nD}=\lambda_{nL}=0$. (The subscript D applies to the driver transistor and the subscript L applies to the load transistor.) Find the V_0 for (a) $V_I=5V$ and (b) $V_I=1.5V$.
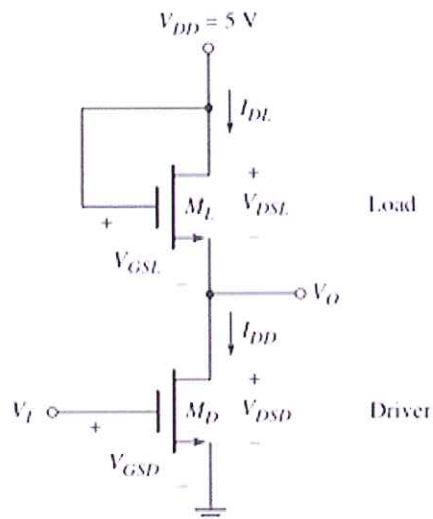

Fig. 6

試題七：〈30 分〉

Calculate the small-signal voltage gain of the bipolar transistor circuit shown in Fig. 7. Assume the transistor and circuit parameters are:

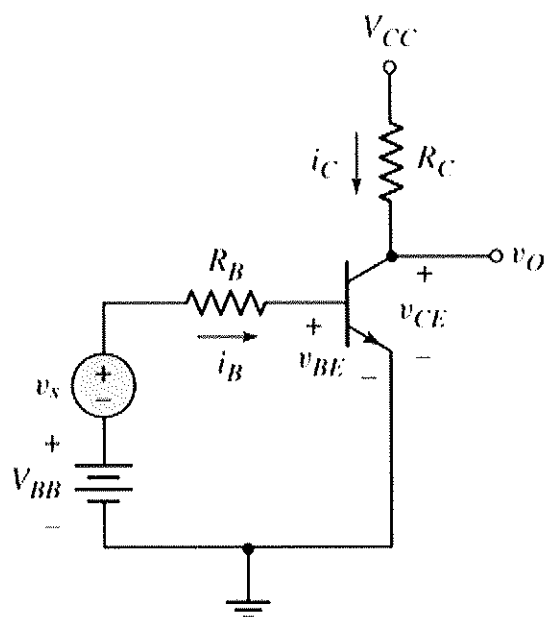$\beta=100$, $V_{CC}=12V$, $V_{BE}=0.7V$, $R_C=6k\Omega$, $R_B=50k\Omega$, $V_T=0.026V$ and $V_{BB}=1.2V$.

Fig. 7

試題八：〈30 分〉

Calculate the differential-mode gain, common-mode gain and common-mode rejection ratio of diff-amp.

Consider the circuit in Fig. 8, with parameters: $V^+=10V$, $V^-=-10V$, $I_Q = 0.8$ mA, and $R_C= 12$ kΩ. The transistor parameters are $\beta=100$,

$V_T = 0.026V$ and $V_A = \infty$. Assume the output resistance looking into the constant-current source is $R_o = 25 \text{ k}\Omega$. Assume the source resistors R_B are zero.
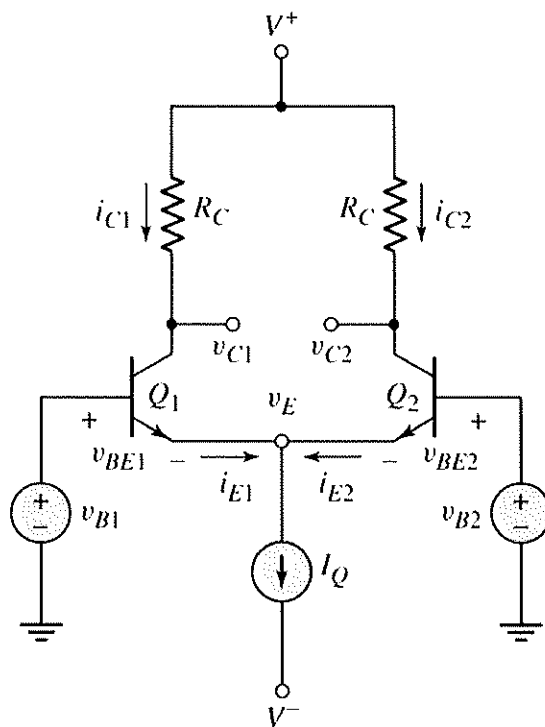

Fig. 8