系級班別：＿＿＿＿＿＿＿＿    學號：＿＿＿＿＿＿＿＿    姓名：＿＿＿＿＿＿＿＿

(無參考資料，可用計算機) 請在答案卷右上方畫上成績欄，謝謝。

(30%) 1. (a) Consider the input circuit of the 741 op amp of Fig.1a below, when the emitter current of $Q_8$ is about 20uA. If β of $Q_1$ is 200 and that of $Q_2$ is 250, find the input bias current $I_B$ and the input offset current *Ios* of the op amp. (10%)

(b) Design the Widlar current source of Fig.1b to generate a current $I_{C10}$=10uA given that $I_{REF}$=1mA, if at a collector current of 1mA, $V_{BE}$=0.7V, find $V_{BE11}$, $V_{BE10}$, and $R_4$. (10%)

(c) For a modified 741 whose second pole is at 5MHz. what dominant-pole frequency is required for 45° phase margin with a close-loop gain of 40dB? Assuming Cc continues to control the dominant pole. What value of Cc would be required? Assume $g_m=2\times10^{-3}$, A0=105dB (10%)
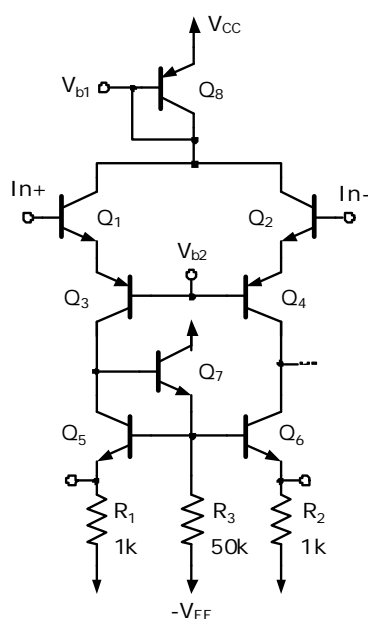


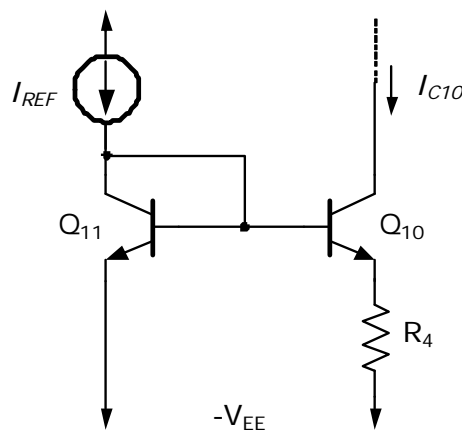Fig. 1a                    Fig. 1b

(30%) 2. (a) Find intermediate node voltage at Vx during the operation of the 3-bit charge-redistribution converter shown in Fig. 2 when $V_{in}$=1.24V and $V_{ref}$=5V. (15%)

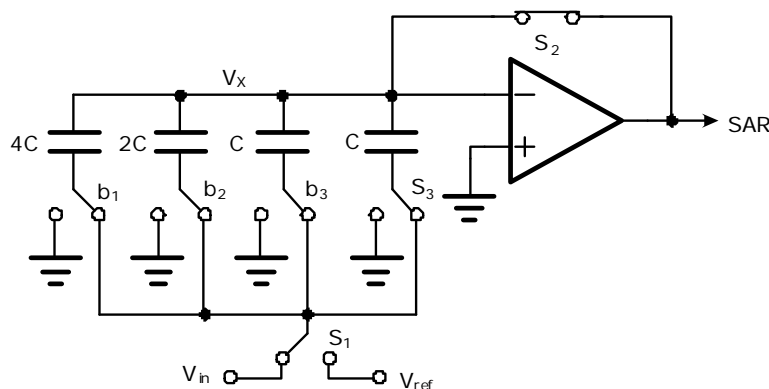(b) Describe the operational principle of a 2-bit R-2R D/A converter. (15%) (Show figures if necessary)



Fig. 2

(25%) 3. (a) For the emitter follower of Fig. 3, let $V_{CC}$=10V, I=100mA, and $R_L$=100Ω. If the output voltage is an 8-V-peak sinusoid, find the following: (i) the power delivered to the load (5%) (ii) The average power drawn from the supplies (5%) (iii) The power-conversion efficiency, ignore the loss in $Q_3$ and R. (5%)

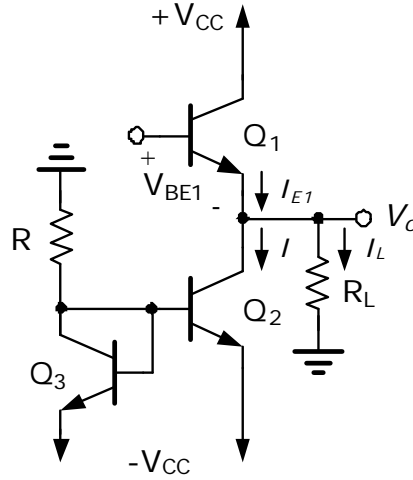(b) Explain why 78.5% maximum efficiency can be achieved by a class-B output stage. (10%) (Show figures if necessary)



Fig. 3

(15%) 4. A BJT is specified to have $T_{Jmax}$=150℃ and to be capable of dissipating maximum power as follows:

40W at $T_C$=25℃, 2W at $T_A$=25℃

Above 25℃, the maximum power dissipation is to be derated linearly with $\theta_{JC}$=3.12℃/W and $\theta_{JA}$=62.5℃/W. Find

(a) The maximum power that can be dissipated safely by this transistor when operated in free air at $T_A$=50℃. (5%)

(b) The maximum power that can be dissipated safely by this transistor when operated at an ambient temperature of 50℃, but with a heat sink for which $\theta_{CS}$=0.5℃/W and $\theta_{SA}$=4℃/W. Find the temperature of the case and of the heat sink. (5%)

(c) The maximum power that can be dissipated safely if an *infinite heat sink* is used and $T_A$=50℃. (5%)



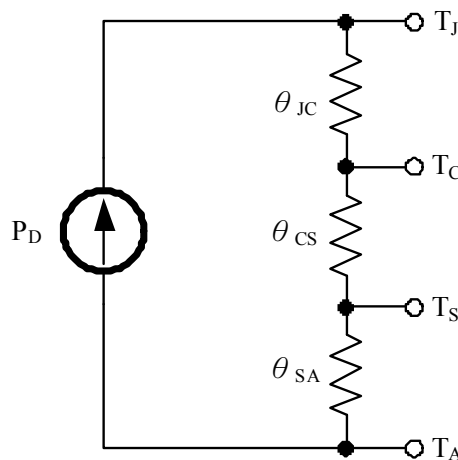Fig. 4