1. Find the transfer function of the network $V_o(s)/V_s(s)$ in Figs. 1(a) and 1(b). (20 分)

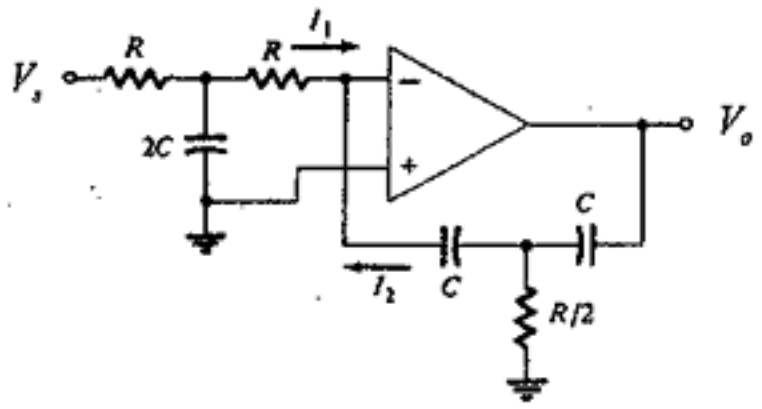

Fig. 1(a)

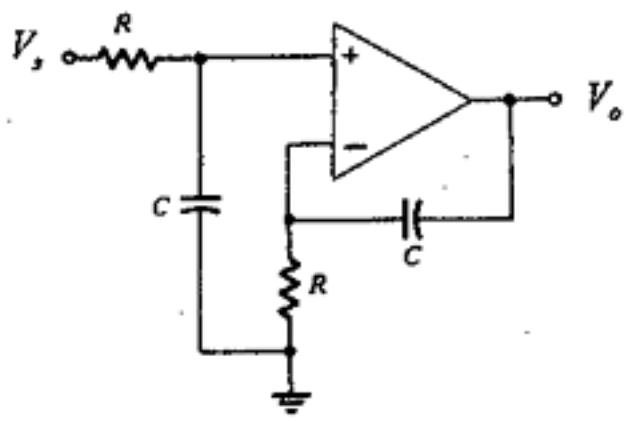

Fig. 1(b)

2. For the transistor phase-shift oscillator shown in Fig. 2, the bias resistors R_1 and R_2 have negligible effect and C' is sufficiently large that it acts as a perfect bypass. Assume $r_\pi << R$. Find (a) the oscillation frequency, (b) the minimum value of β of the transistor required for oscillation. (20 分)

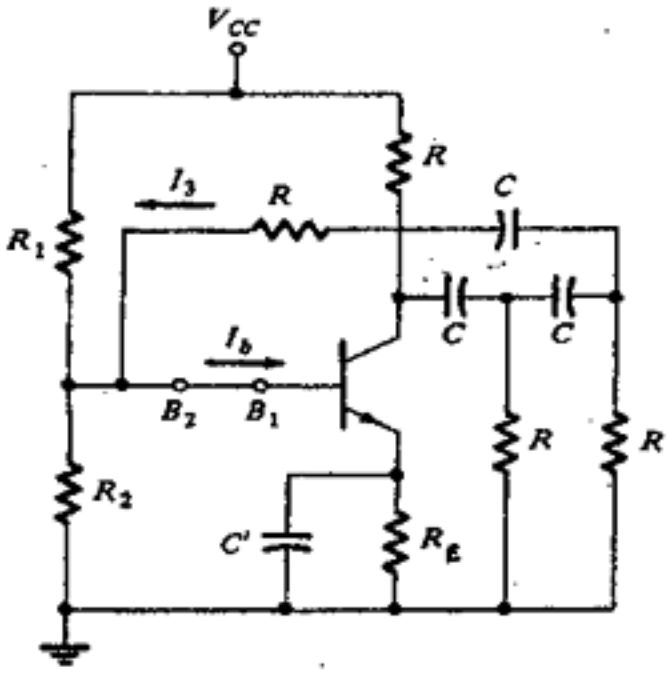

Fig. 2

3. Figure 3 shows a monostable multivibrator circuit. In the stable state, $v_O = L_+$, $v_A = 0$, and $v_B = -V_{ref}$. The circuit can be triggered by applying a positive input pulse of height greater V_{ref}. For normal operation, $C_1R_1 << CR$. Show the resulting waveforms of v_O and v_A. Also, determine the pulse width T at the output. (15 分)

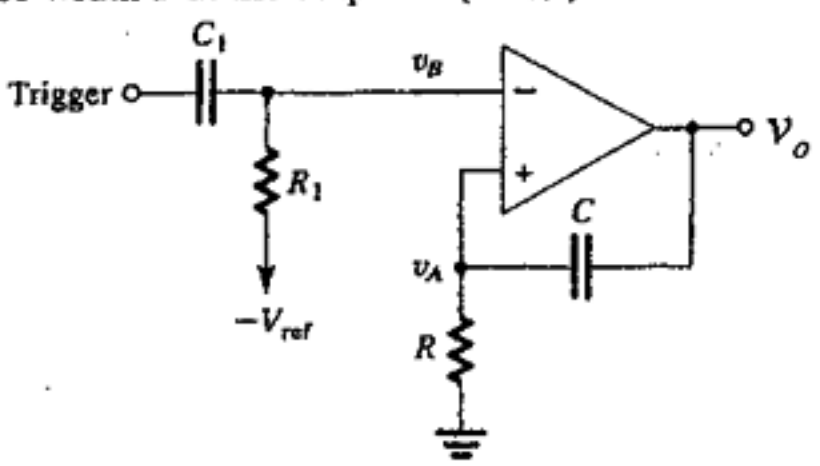

Fig. 3

(背面仍有題目,請繼續作答)

4. For the circuit in Fig. 4, assuming all transistors to have large β, show that $i_O = v_i / R$. For $\beta = 100$, by what approximate percentage is i_O actually lower than this? (15 分)

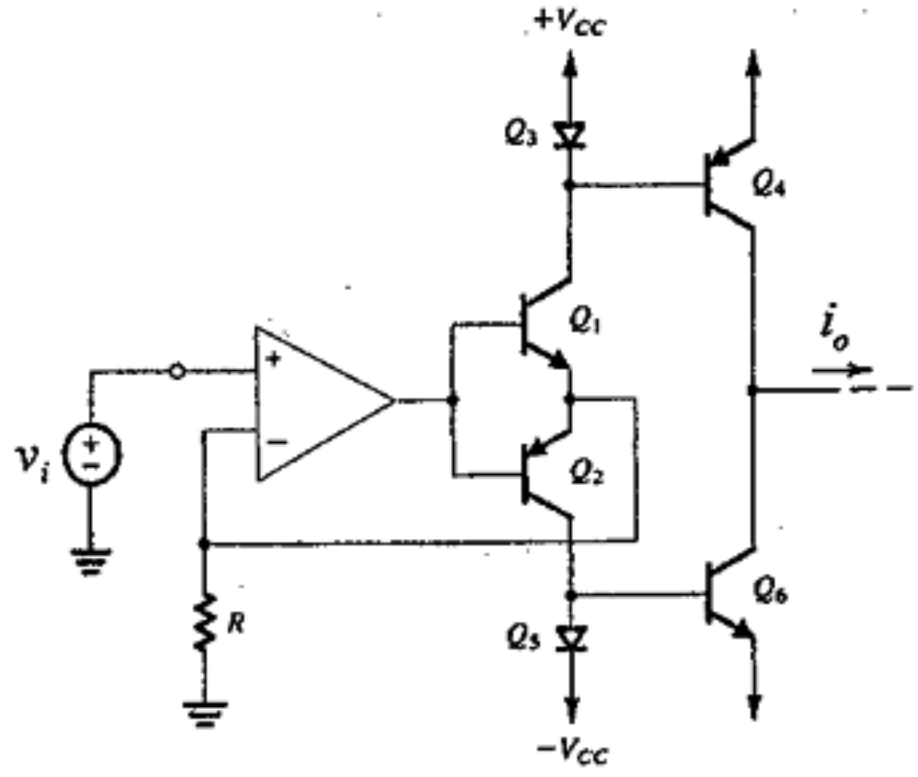

Fig. 4

5. Consider a feedback amplifier for which the open-loop gain $A(s)$ is given by

$$A(s) = \frac{1000}{(1+s/10^4)(1+s/10^5)^2}$$

If the feedback factor β is independent of frequency, find the frequency at which the phase shift is 180°, and find the critical value of β at which oscillation will commence. (15 分)

6. Use an op-amp and some resistors to design a circuit to obtain

$$v_O = v_1 + 2v_2 - 2v_3$$

Draw the circuit. The smallest resistor used should be $10\ \text{k}\Omega$. (15 分)