按題目順序書寫答案

1. For $V_{DD} = 2\,V$ and using $I_{REF} = 50\,\mu A$, it is required to design the circuit of Fig. 1 to obtain an output current whose nominal value is $300\,\mu A$.

(a) Find R if Q_1 has channel length of $0.5\,\mu m$, channel width of $5\,\mu m$, $V_t = 0.5\,V$ and $k_n' = 250\,\mu A/V^2$, and Q_2 has channel length of $0.5\,\mu m$, channel width of $30\,\mu m$, $V_t = 0.5\,V$ and $k_n' = 250\,\mu A/V^2$.　　(7分)

(b) What is the lowest possible value of V_O?　　(5分)

(c) Assuming the Early voltage $V_A = 20\,V$, find the change in output current resulting from +1 V change in V_O.　　(8分)

Fig. 1

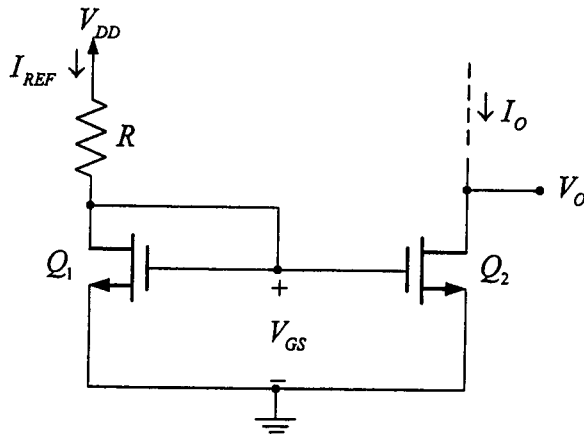2. A wave generator is shown in Fig. 2. The zener voltage is 6.8 V. The resistors $R_1 = 50\,k\Omega$, $R_2 = 100\,k\Omega$, $R_3 = R_4 = R_5 = R_6 = 10\,k\Omega$, $R_7 = 5\,k\Omega$ and $C = 0.1\,\mu F$.

(a) Sketch and label the waveforms v_A, v_B and v_O.　　(15分)
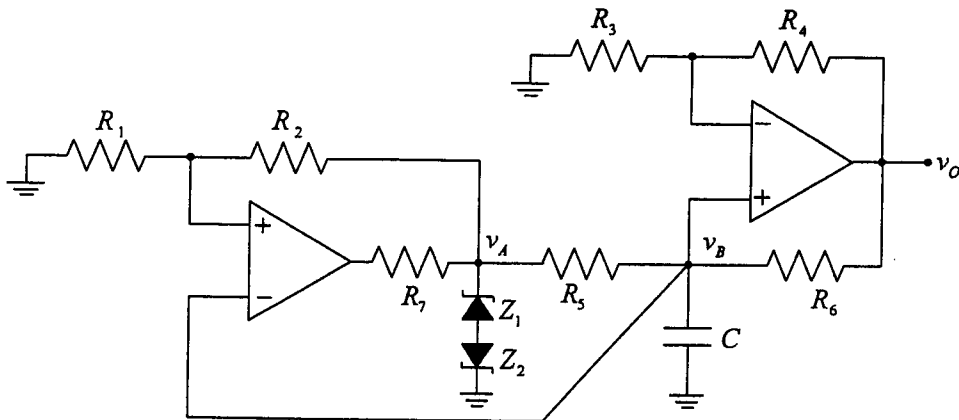
(b) Determine the frequency of v_O.　　(5分)

Fig. 2

（背面仍有題目,請繼續作答）

3. An amplifier circuit shown in Fig. 3 employs an op amp1 having a dc gain of 1000 V/V and 3-dB frequency of 1000 rad/s, and an op amp 2 having a dc gain of 1000 V/V and 3-dB frequency of 2000 rad/s.

    (a) What is the 3-dB frequency of the amplifier circuit?   (17 分)

    (b) What is the voltage gain of the amplifier circuit at 10^5 rad/s?   (3 分)
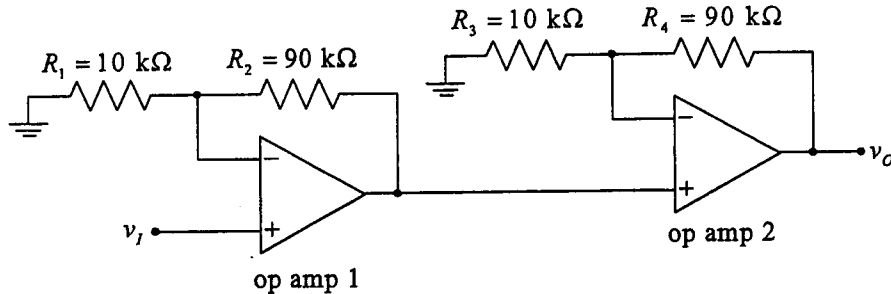

Fig. 3

4. For the voltage-regulator circuit shown in Fig. 4, all diodes are identical with $n=2$, conducting 10 mA at 0.7 V and 100 mA at 0.8 V. If the supply voltage $V_S = 10 + 0.67\sin 1000t$ V, what is the output voltage V_O?   (20 分)
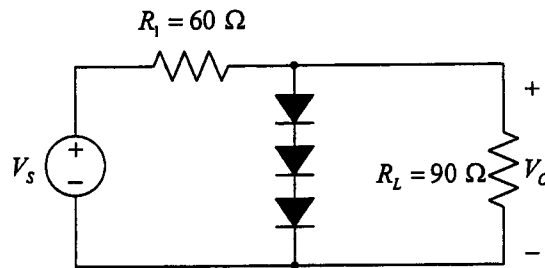

Fig. 4

5. Consider the class AB output stage shown in Fig. 5 in which Q_2 and Q_4 are matched transistors with $V_{BE} = 0.7$ V at 10 mA and $\beta = 100$, Q_1 and Q_5 have $V_{BE} = 0.7$ V at 1 mA and $\beta = 100$, and Q_3 has $V_{EB} = 0.7$ V at 1 mA and $\beta = 10$. Design the circuit for a quiescent current of 2 mA in Q_2 and Q_4, I_{BIAS} that is 100 times the standby base current in Q_1, and a current in Q_5 that is 9 times that in the associated resistors. Find the values of R_1 and R_2.   (20 分)
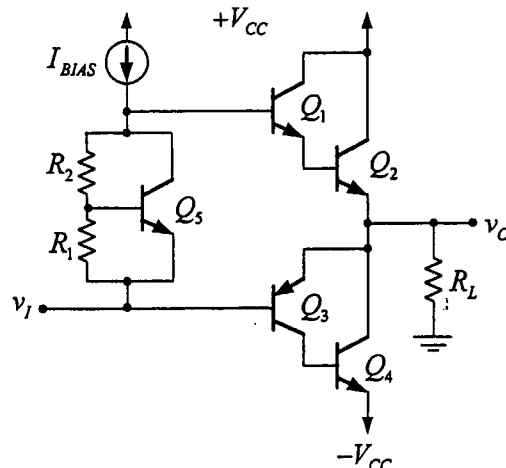

Fig. 5