1. For the BJT amplifier shown in Figure 1, answer the following questions. The parameters are $v_b = 5$ V, the current through R_2 is 1 mA, $|V_A| = 200$ V, $V_T = 25$ mV, and the base current can be neglected.

   (a) Find the values of R_1 and R_2. (6%)

   (b) Find the bias current of the transistor I_C ($V_{BE} = 0.7$ V). (4%)

   (c) If $R_3 = 4$ kΩ, find R_{in} and R_o. (10%)

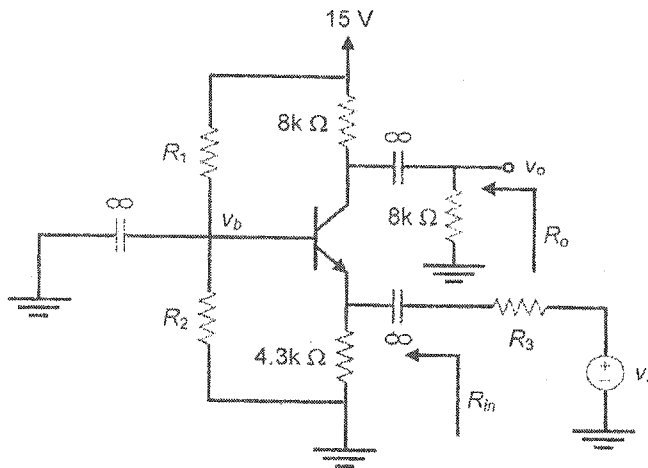   (d) Determine the small signal gain $A_v = v_o/v_s$. (5%)

Fig. 1

2. For the active first-order filter shown in Figure 2, answer the following questions:

   (a) Determine the transfer function $H(s) = V_o/V_s$, where $s = j\omega$. (5%)

   (b) What condition is required for the circuit to operate as a highpass filter? (5%). Draw the magnitude Bode plot and find the 3-dB frequency. (5%)

   (c) What condition is required for the circuit to operate as a lowpass filter? (5%) Draw the magnitude Bode plot and find the 3-dB frequency. (5%)
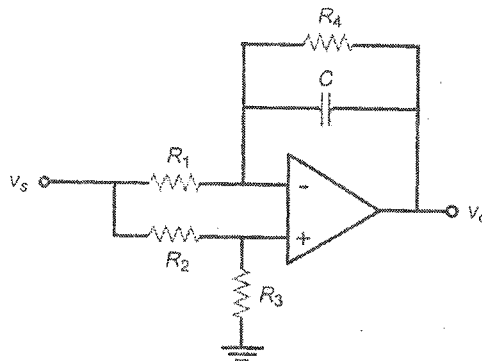

Fig. 2

注意：背面有試題

3. Consider the circuit shown in Figure 3. The forward-bias cut-in voltage of the diode is V_{TH} and the forward-bias resistance is r_f.

(5%)　　(a) Determine the minimal electric current in *LED*.

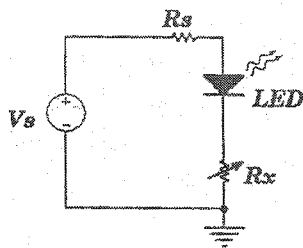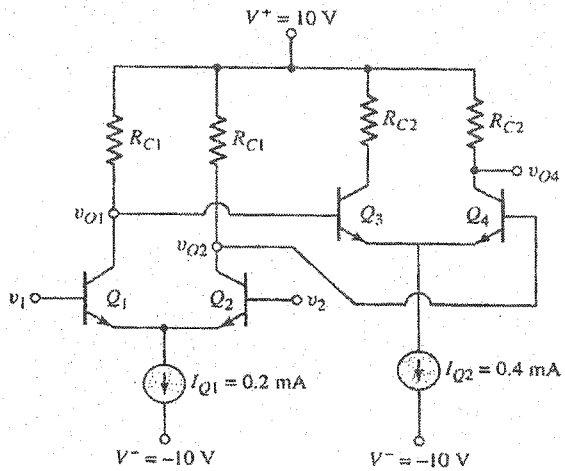(5%)　　(b) Determine the maximal electric current in *LED*.

參考用

Fig. 3:

Fig. 4:

4. Consider the circuit shown in Fig. 4. The parameters are $\beta = 180$ and $V_A = \infty$. $v_{o1} = v_{o2} = 2$ V and $v_{o4} = 6$ V when $v_1 = v_2 = 0$ V.

(5%)　　(a) Determine the value of R_{C1}.

(5%)　　(b) Determine the value of R_{C2}.

(5%)　　(c) Determine the differential-mode voltage gain $A_{d1} = (v_{o1} - v_{o2})/(v_1 - v_2)$.

(5%)　　(d) Determine the differential-mode voltage gain $A_d = v_{o4}/(v_1 - v_2)$.

5. Consider the phase-shift oscillator in Figure 5.

(5%)　　(a) Derive the expression for the frequency of oscillation.

(5%)　　(b) Determine the condition for oscillation.

(5%)　　(c) For $R=20\text{k}\Omega$, find C and R_F that will produce sustained oscillations at $f_o=22\text{kHz}$.
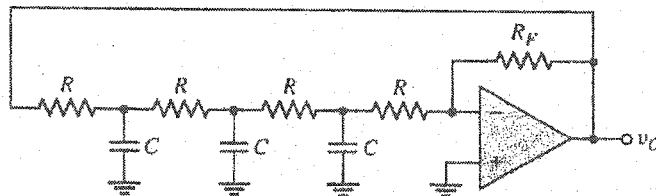
(5%)　　(d) Sketch the Bode phase plot.

Fig. 5

注意：背面有試題