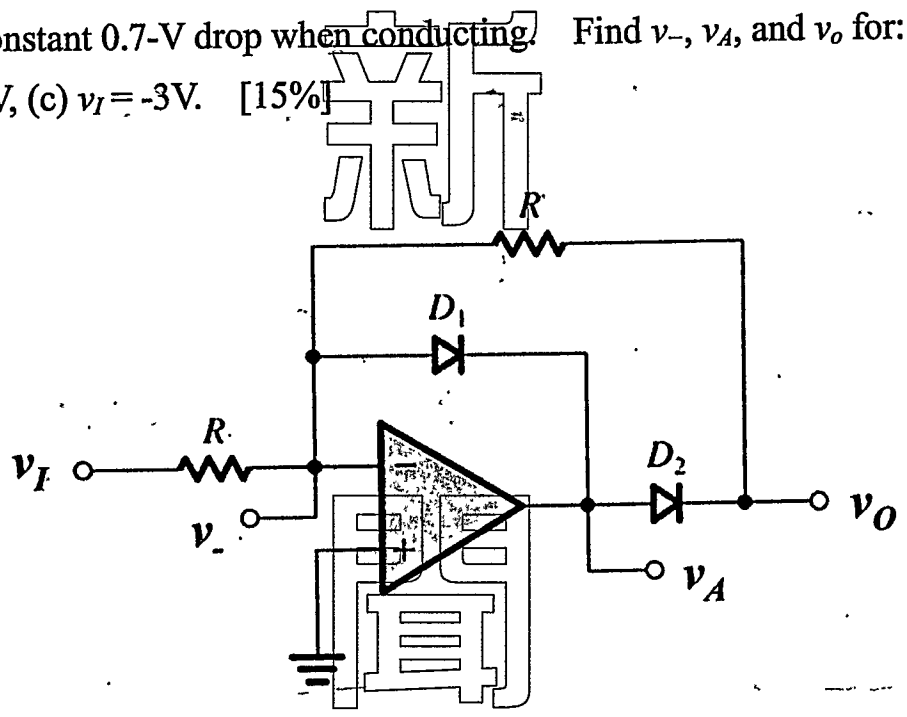
科目：電子學 適用：電機系

編號：351

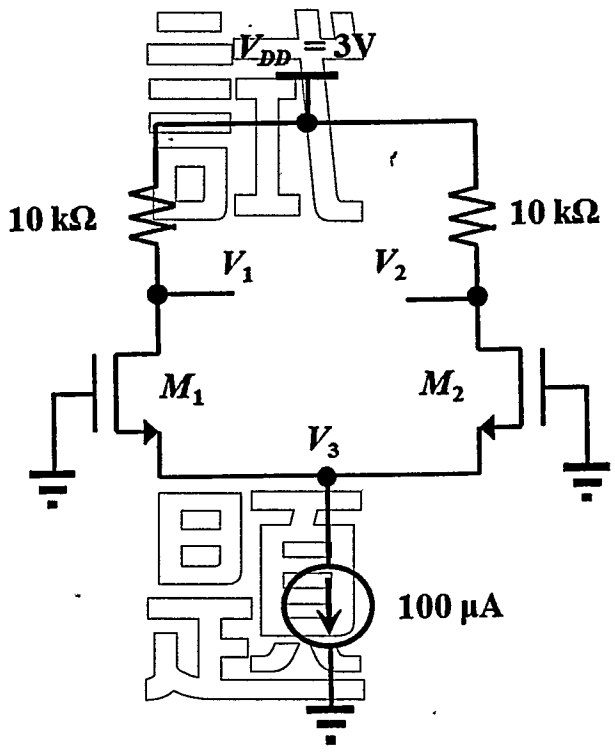
考生注意：
1.依次序作答，只要標明題號，不必抄題。
2.答案必須寫在答案卷上，否則不予計分。
3.限用藍、黑色筆作答；試題須隨卷繳回。

1. Find the resistivity of (a) intrinsic silicon, and (b) n-type silicon with $N_D = 10^{16}/\text{cm}^3$. Use $n_i = 1.5 \times 10^{10}/\text{cm}^3$, and assume that for intrinsic silicon $\mu_n = 1200\ \text{cm}^2/\text{V}\cdot\text{s}$ and $\mu_p = 400\ \text{cm}^2/\text{V}\cdot\text{s}$. Resistivity $\rho = \dfrac{1}{q(p\mu_p + n\mu_n)}$, where $q = 1.6 \times 10^{-19}$. [10%]

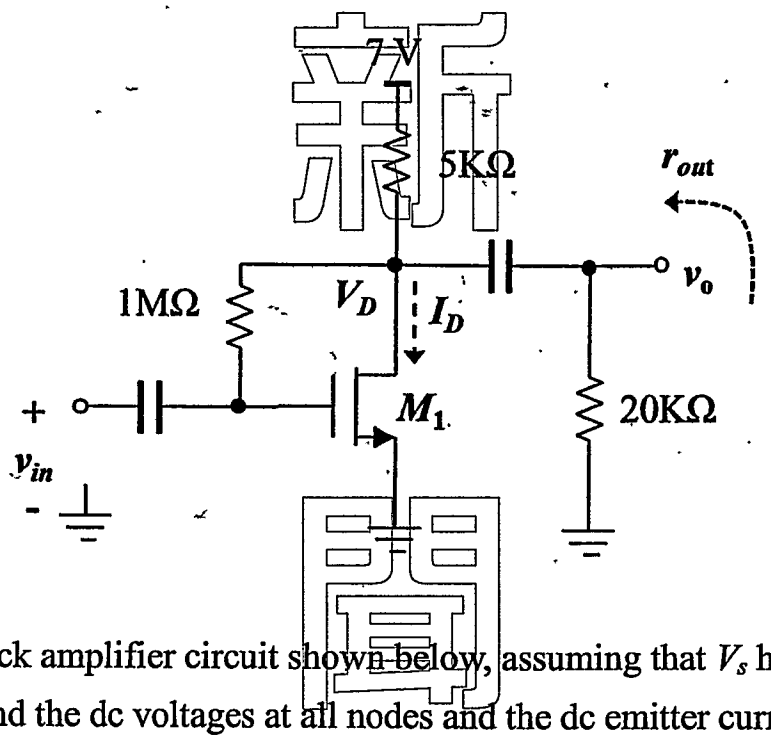
2. The op amp in the circuit below is ideal with output saturation levels of ±10 V. The diodes exhibit a constant 0.7-V drop when conducting. Find v_-, v_A, and v_o for: (a) $v_I = +1$V, (b) $v_I = +3$V, (c) $v_I = -3$V. [15%]



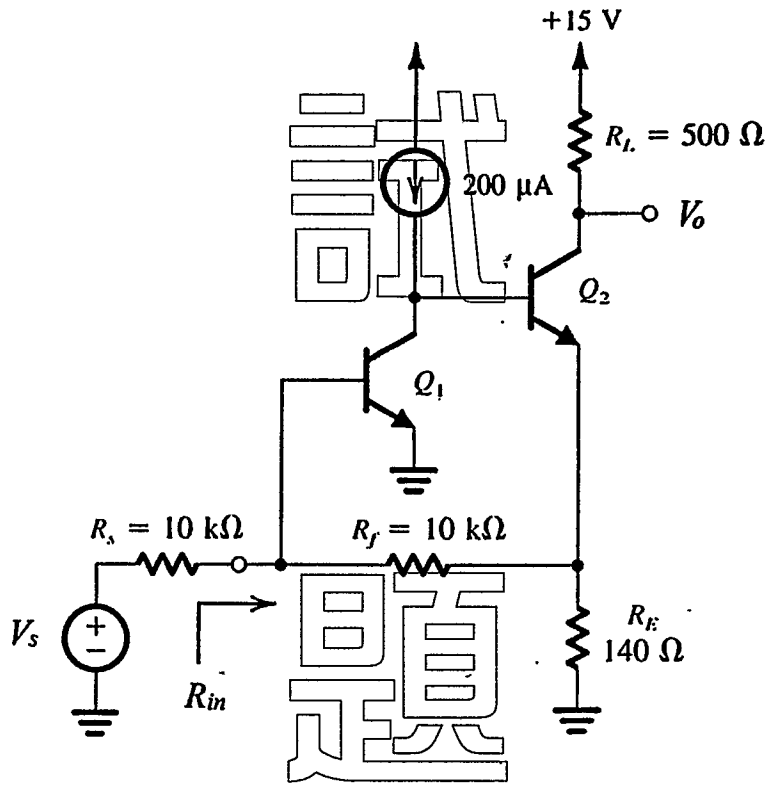
3. For the circuit shown below, transistors M_1 and M_2 have $V_t = 0.5$ V, and the process transconductance parameter $k'_n = 100\ \mu\text{A/V}^2$. Find V_1, V_2, and V_3 for each of the following cases: (a) $(W/L)_1 = (W/L)_2 = 10$, and (b) $(W/L)_1 = 2\cdot(W/L)_2 = 10$ [20%]



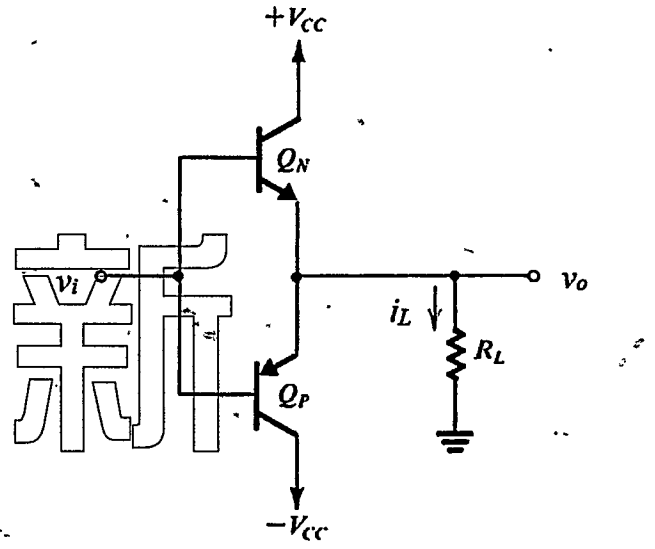
4. Assume the capacitors in the circuit below to be sufficiently large so as to act as short circuit at the signal frequencies of interest. M_1 has $V_t = 1\text{V}$, $k'_n(W/L) = 0.4\text{mA/V}^2$, and $V_A = 40\text{V}$. Find (a) the dc value of V_D and I_D. (b) Draw its small-signal equivalent circuit. (c) Find the small signal voltage gain $A_v = v_o/v_{in}$, and output resistance r_{out}. [15%]



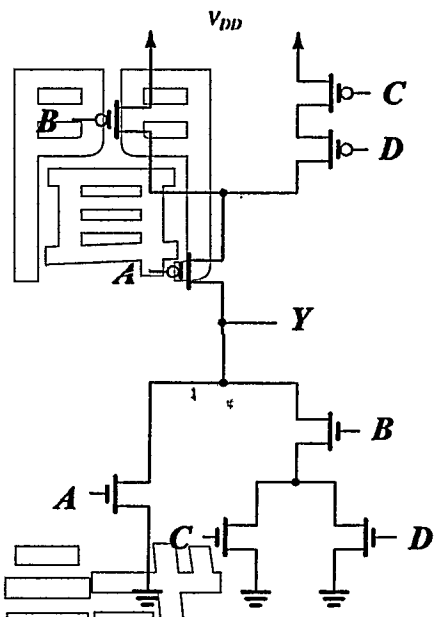
5. For the feedback amplifier circuit shown below, assuming that V_s has a zero dc component, find the dc voltages at all nodes and the dc emitter currents of Q_1 and Q_2. Let the BJTs have $\beta = 100$. Use feedback analysis to find V_o/V_s and R_{in}. Let $V_{BE} = 0.7$ V. [20%]



6. For the class B output stage shown below, show that its maximum power conversion efficiency is 78.5%. [10%]



7. For the CMOS logic circuit shown below, A, B, C and D are digital inputs, what is the logic function of Y? [5%]



8. For the instrument amplifier shown below, assume all op amps are ideal. $v_d = v_2 - v_1$, find the voltage gain $A_o = v_o/v_d$. [5%]