

國立臺灣科技大學

八十九學年度碩士班招生考試試題

系所組別：電子工程系丙組

科目：電子學

(總分共 100 分)

1. (10 %) Please sketch the typical circuit diagram of SRAM and DRAM memory cell, respectively.

2. (15 %) The circuit shown in Fig. 2-1 is called as the common-gate amplifier. For this circuit find (a) the voltage gain (b) the input impedance (c) the output impedance. Using the MOSFET small signal model shown in Fig. 2-2.

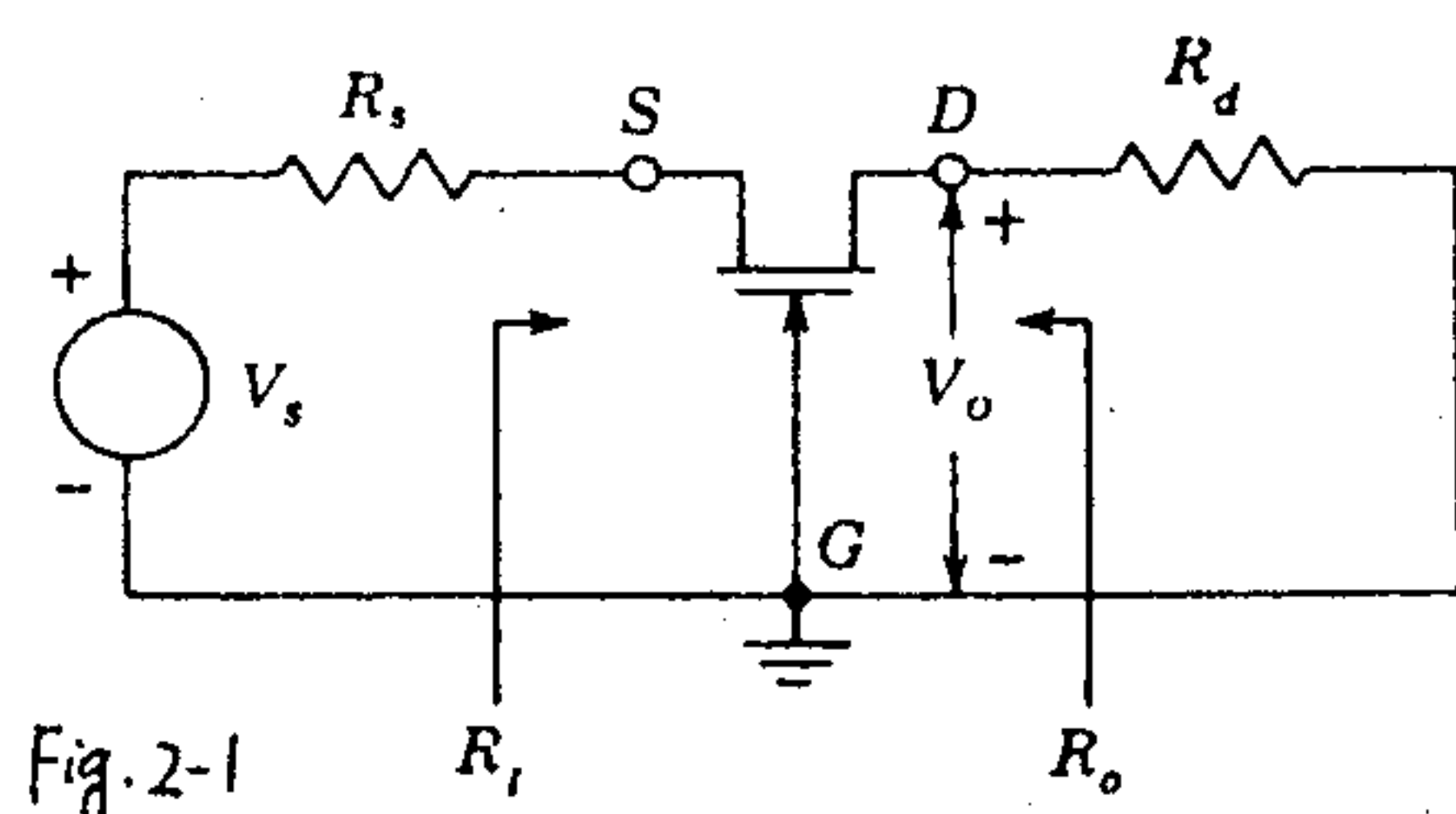


Fig. 2-1

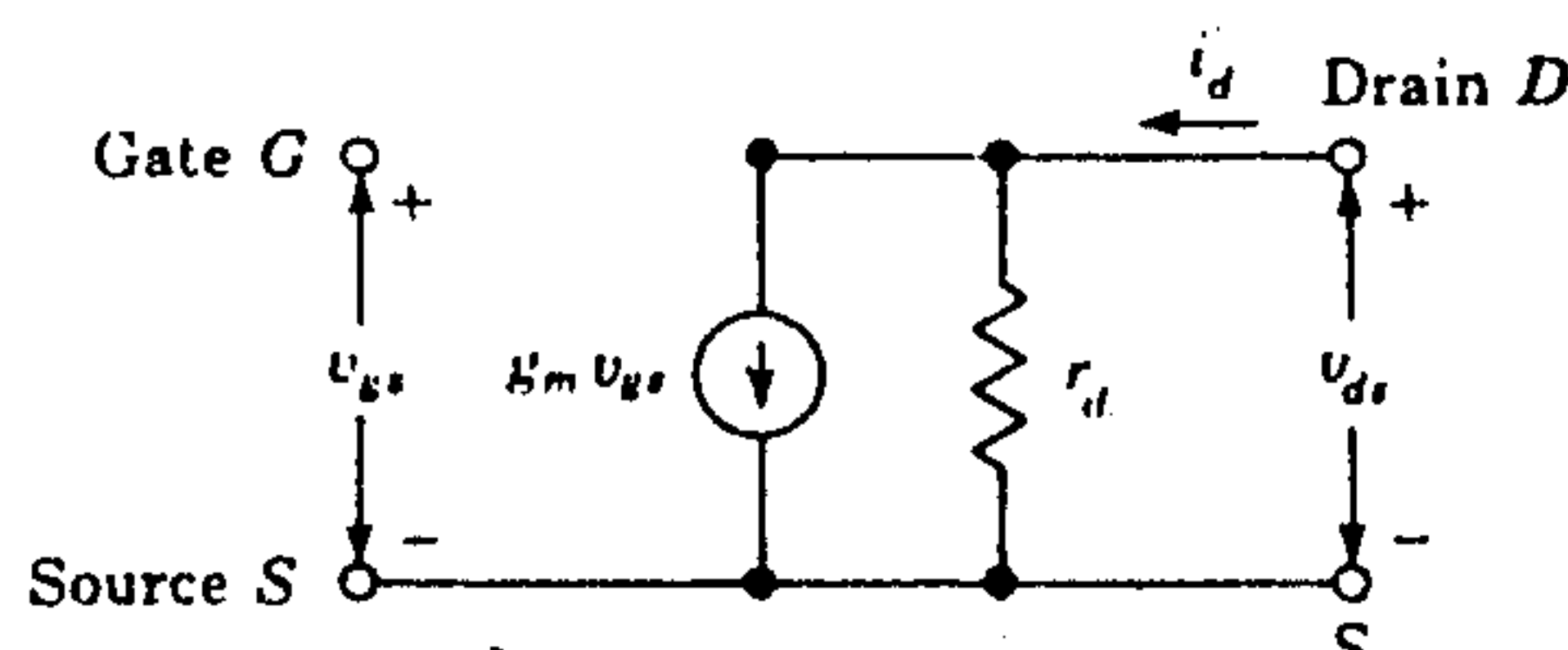
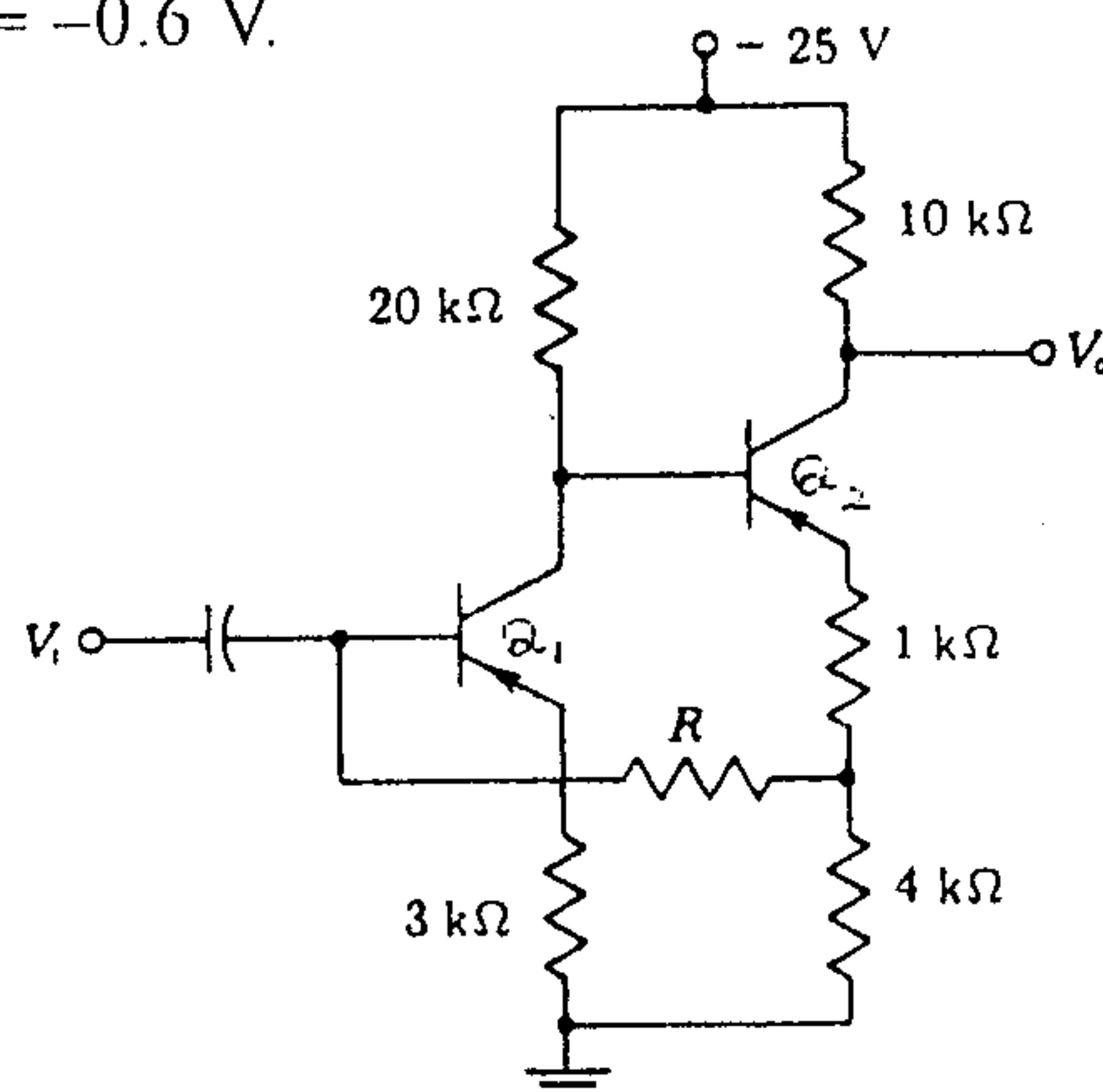


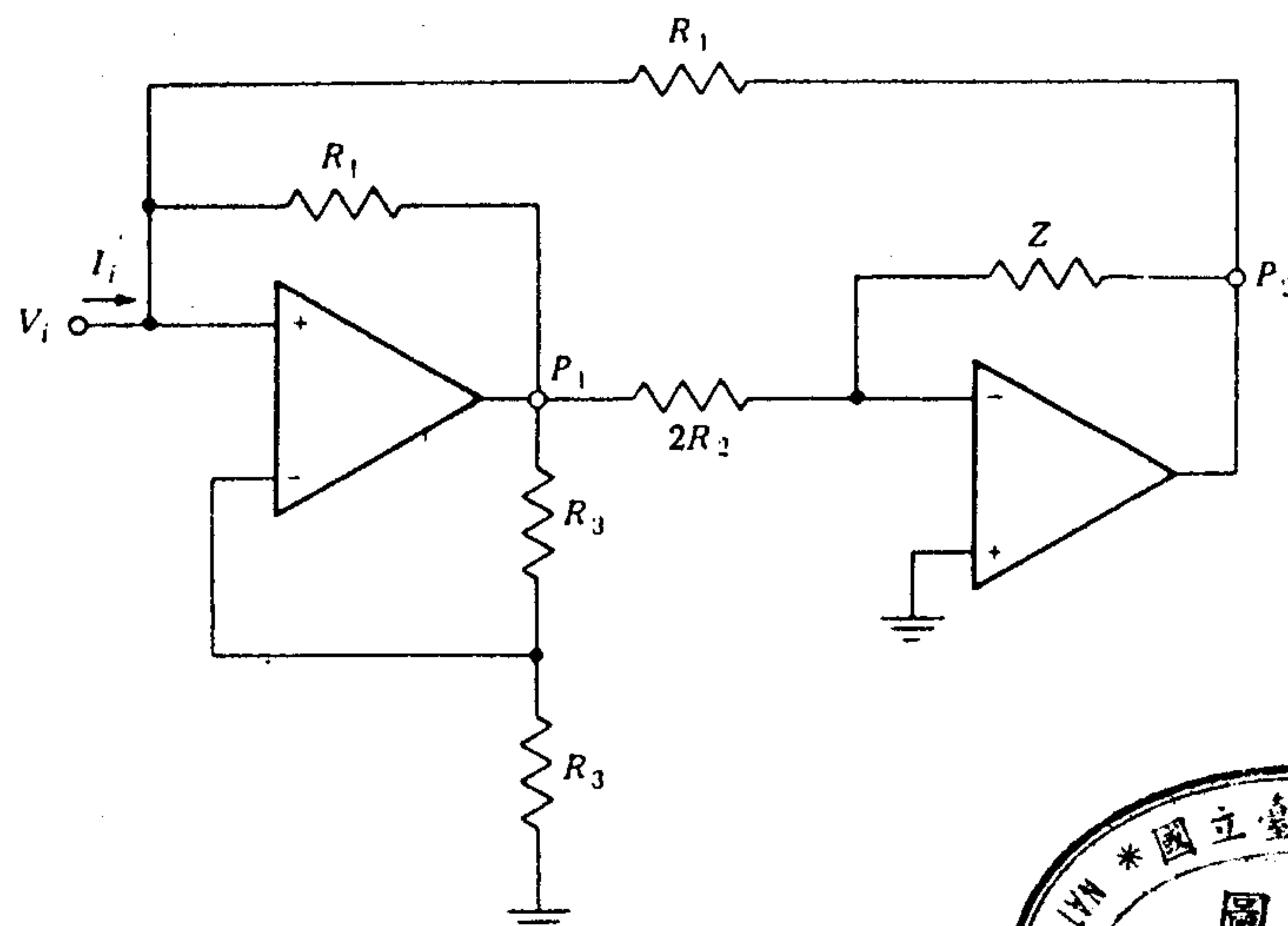
Fig. 2-2

3. (10 %) In the two-stage circuit shown, assume $\beta = 100$ for each transistor. Please determine R so that the quiescent conditions are $V_{CE1} = -5\text{ V}$ and $V_{CE2} = -6\text{ V}$. Assume $V_{BE} = -0.6\text{ V}$.



4. (10 %) (a) Show the input impedance V_i/I_i of the circuit as a function of R_1 , R_2 , and Z .

(b) Find the value of Z in order to obtain a 1-H inductance, if $R_1 = R_2 = 1\text{ k}\Omega$.



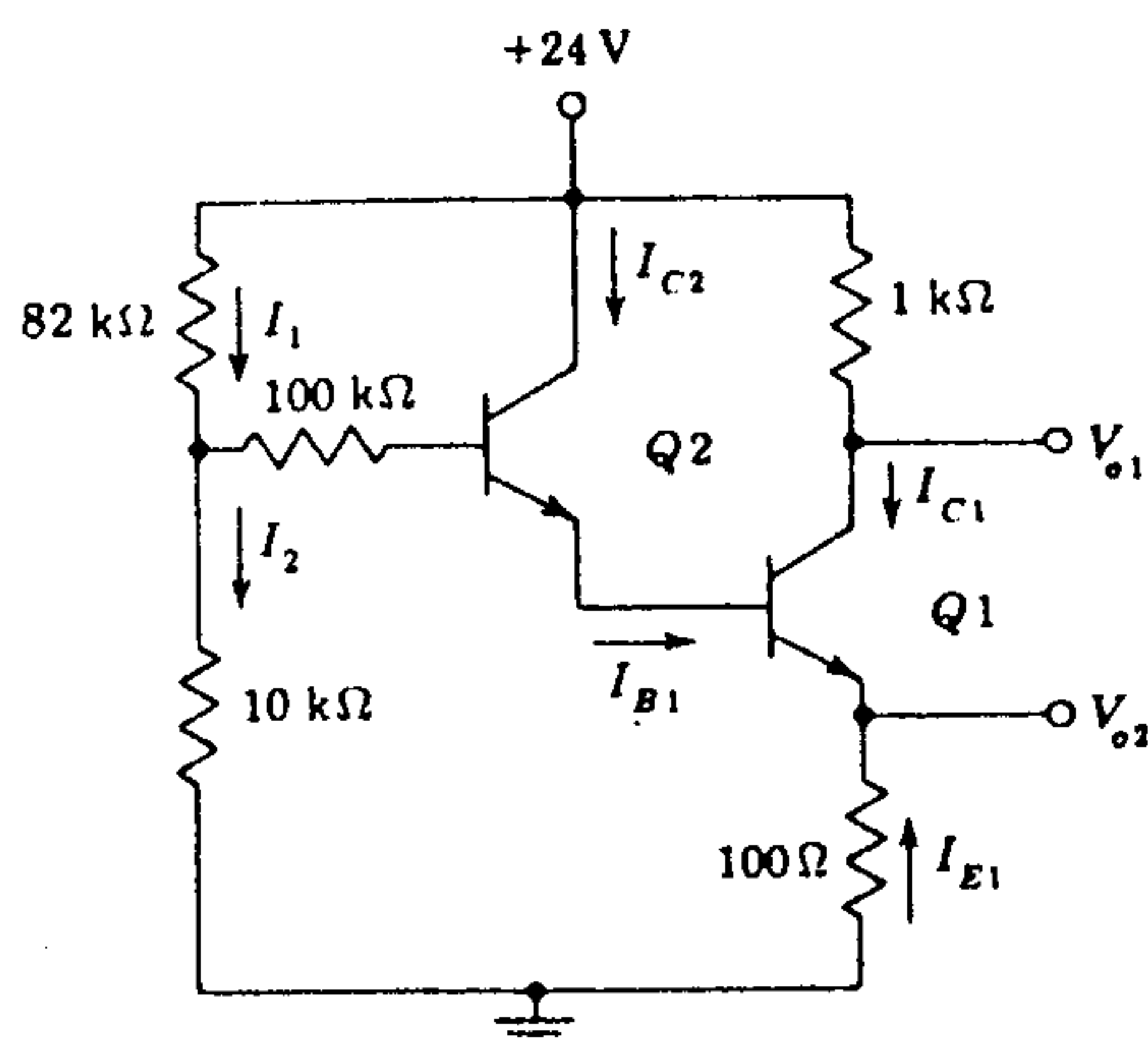
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5. (10 %) For the circuit shown, transistors Q_1 and Q_2 operate in the active region with $V_{BE1} = V_{BE2} = 0.7$ V, $\beta_1 = 100$, and $\beta_2 = 50$. The reverse saturation currents may be neglected. Please find the output voltage V_{o1} and V_{o2} .



6. (10 %) Derive the expression for obtaining the carrier concentration via the Hall-effect measurement, for a p-type semiconductor.

7. (10 %) Please derive that the density of allowed states per unit volume, $N(E)$ is $N(E) = 4\pi [2m_n/h^2]^{3/2} E^{1/2}$ where h is Planck constant and m_n is effective mass of electron.

8. (10 %) For a Si p-n junction with concentration of N_A and N_D , respectively, please show that built-in potential can be expressed as

$$V_{bi} = (kT/q) \ln (N_A N_D / n_i^2)$$

Please also sketch the related band diagram to explain that.

9. (15 %) The electron density as a function of temperature for a Si sample with a donor concentration of 10^{15} cm^{-3} is shown. Please explain the physical meanings of A, B, and C regions, respectively, as detailed as possible.

