

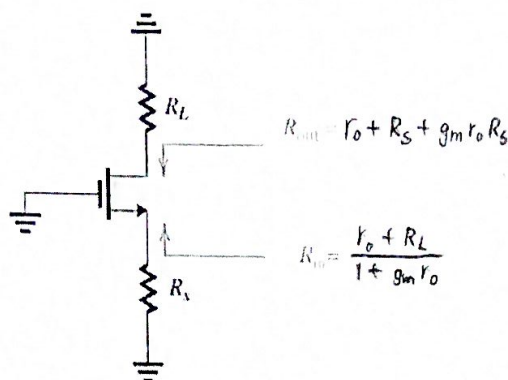
國立成功大學 工程科學系 試題

電子電路 (總分 100 分)

學號 _____ 姓名 _____ 2017/11/10

計算題 5 題(100 分，共 3 頁)。推導過程須要詳細寫出來，若觀念正確，才能斟酌給分。

Note:



1. Transistor Q_1 in the circuit of Fig.1 is operating as a CE amplifier with an active load provided by transistor Q_2 , which is the output transistor in a current mirror formed by Q_2 and Q_3 . (20%)
 - (a) Neglecting the finite base currents of Q_2 and Q_3 and their $V_{BE} = 0.7$ V and that Q_2 has five times the area of Q_3 , find the value of I . (2%)
 - (b) If Q_1 and Q_2 are specified to have $|V_A| = 30$ V, find r_{o1} and r_{o2} . (4%)
 - (c) Find $r_{\pi 1}$ and g_{m1} assuming that $\beta_1 = 50$. (4%)
 - (d) Find R_{in} , R_o , and $A_v \equiv v_o / v_i$. (10%)

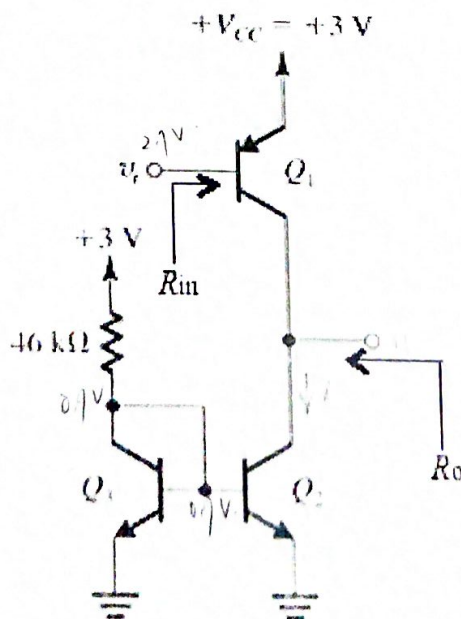


Fig.1

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2. In the common-gate amplifier circuit of Fig.2, Q_2 and Q_3 are matched. $k'_n(W/L)_n = k'_p(W/L)_p = 4\text{mA/V}^2$, and all transistors have $|V_t| = 0.8\text{V}$ and $|V_A| = 20\text{V}$. The signal v_{sig} is a small sinusoidal signal with no dc component. (20%)
- (a) Find the value of R_{in} . (6%)
- (b) Find the value of R_{out} . (6%)
- (c) Calculate the voltage gain v_o / v_{sig} . (8%)

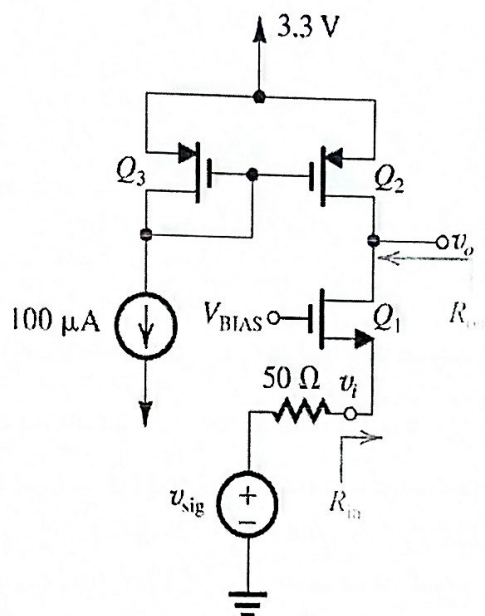


Fig.2

3. For the Darlington circuit in Fig.3, the condition $\beta_1 = \beta_2 = 100$, $r_{o1} = r_{o2} = 10\text{k}\Omega$, $R_{\text{sig}} = 100\text{k}\Omega$, and $R_E = 1\text{k}\Omega$, $I_{E2} = 5\text{mA}$. Find R_{in} , R_{out} , and v_o / v_{sig} . (20%)

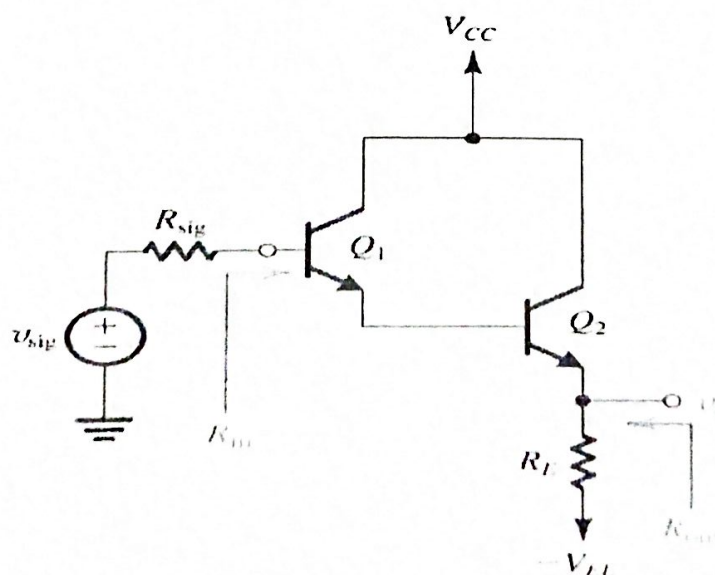


Fig.3

4. For the circuit in Fig.4, find the overall voltage gain v_o / v_i , R_{in} , and R_{out} with $\beta_1 = \beta_2 = \beta$ and $\alpha_1 = \alpha_2 = \alpha$. (neglecting r_o) (20%)

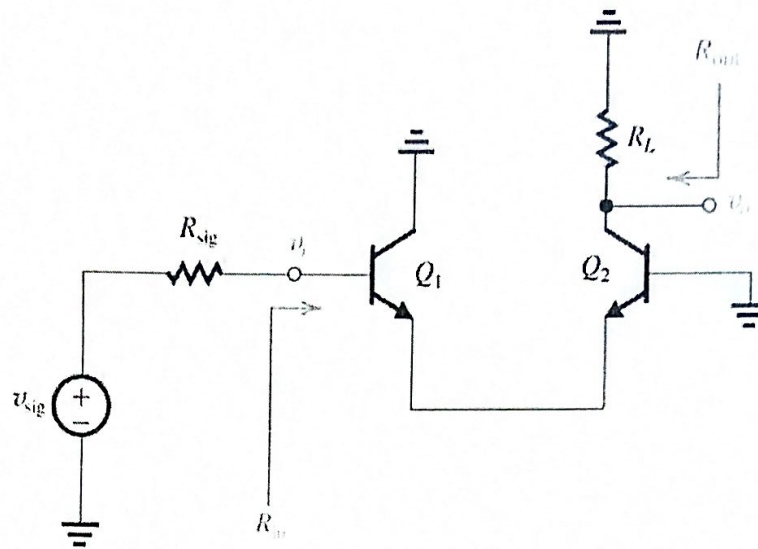


Fig.4

5. For the circuit in Fig.5, let $|V_{BE}| = 0.7V$ and $\beta = \infty$. Find I , V_1 , V_2 , V_3 , V_4 , and V_5 for $R = 100k\Omega$. (Neglecting r_o) (20%)

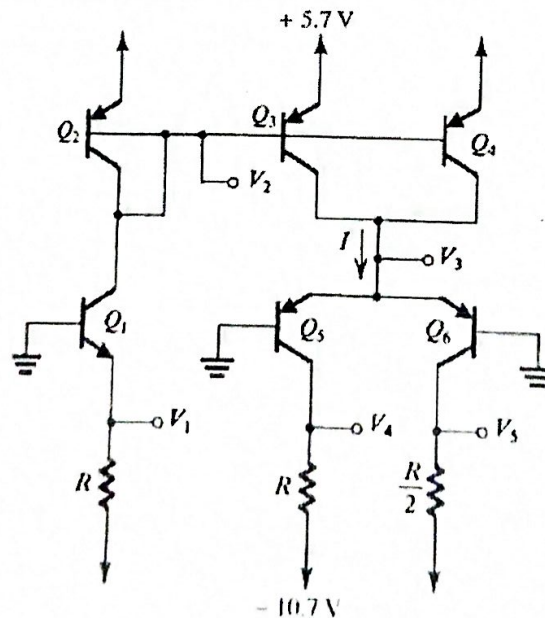


Fig.5