Electronics II, Exam-4, Spring 2020

Department of Communication Engineering, National Central University

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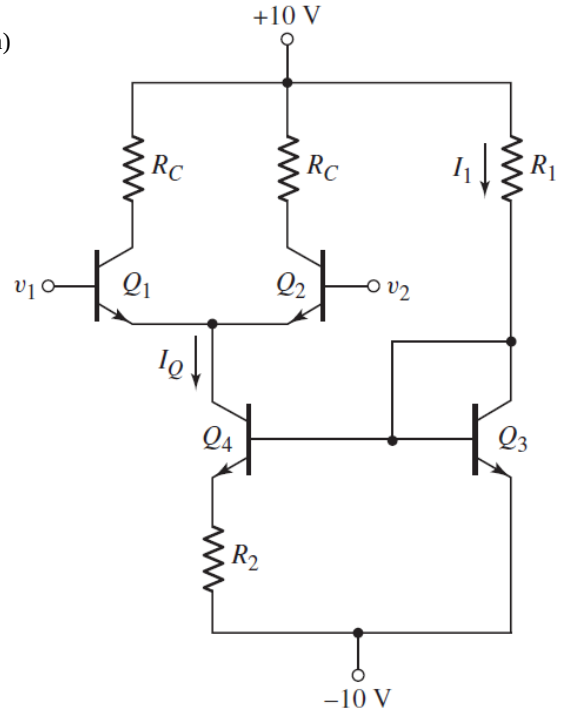
1. (25%) The transistor parameters are $\beta = 180$, $V_{BE(on)}$ = 0.7 V (except for Q4), $V_A = \infty$ for Q1 and Q2, and $V_A = 100$V for Q3 and Q4.

   (a) Assume $R_1 = 38.6\ \text{k}\Omega$, determine R_2 such that $I_Q = 140\ \mu\text{A}$. (5%)

   (b) Determine the common-mode input resistance. (10%)

   (c) For $R_C = 40\ \text{k}\Omega$, determine the common-mode voltage gain. (10%)

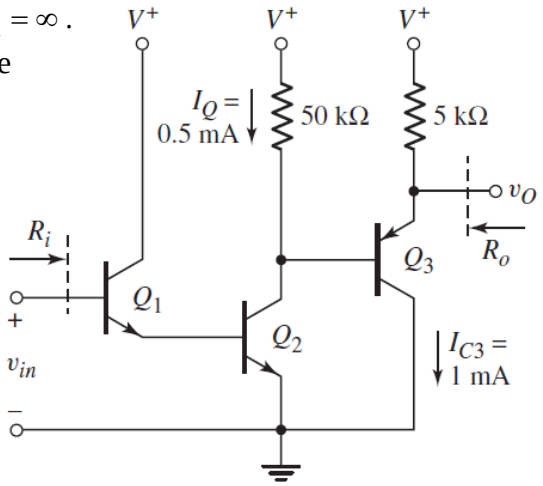


2. (30%) The transistor parameters are β=100 and $V_A = \infty$. The bias currents in the transistors are indicated in the figure.

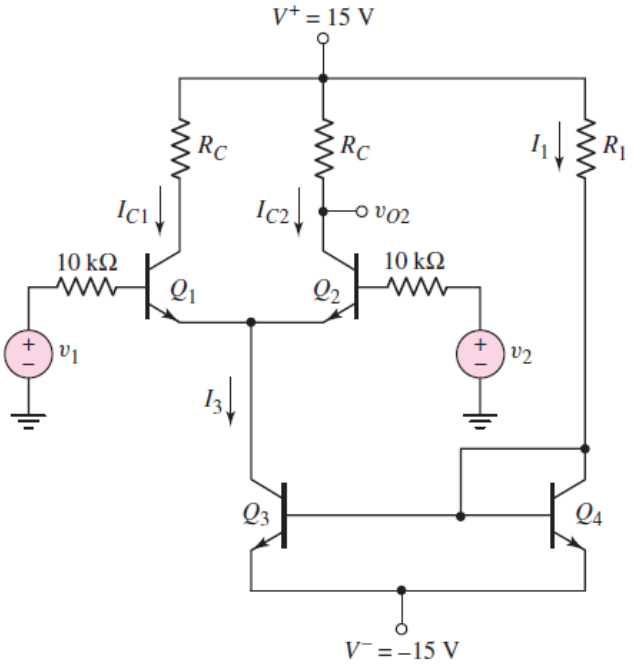
   (a) Determine the input resistance. (5%)

   (b) Determine the output resistance. (10%)

   (c) Find the small-signal voltage gain. (15%)



3. (20%) The transistor parameters are β = 100 and $V_{BE(on)}$ = 0.7 V. The Early voltage is V_A = ∞ for Q1 and Q2, and is V_A = 50 V for Q3 and Q4. Assume $R_1 = 73\ \text{k}\Omega$ and $R_C = 28.5\ \text{k}\Omega$. Find CMRR(dB) for a one-sided output at v_{O2}.



4. (25%) Assume that the parameters of the transistors are $K_n = 0.2mA/V^2, V_{TN} = 2V$, and $\lambda = 0.02V^{-1}$. Determine the differential-mode voltage gain $A_d = v_{O3}/v_d$, where $v_d = v_1 - v_2$.