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Analog Integrated Circuits
Midterm 2
Thursday, April 6, 1995

EECS 140
SPRING 1995

Name: ...

This exam has 3 problems with equal weights. Show how you arrived at each result to get credit. Please *mark results clearly with a box around them.* Write the answers directly on the exam sheets.

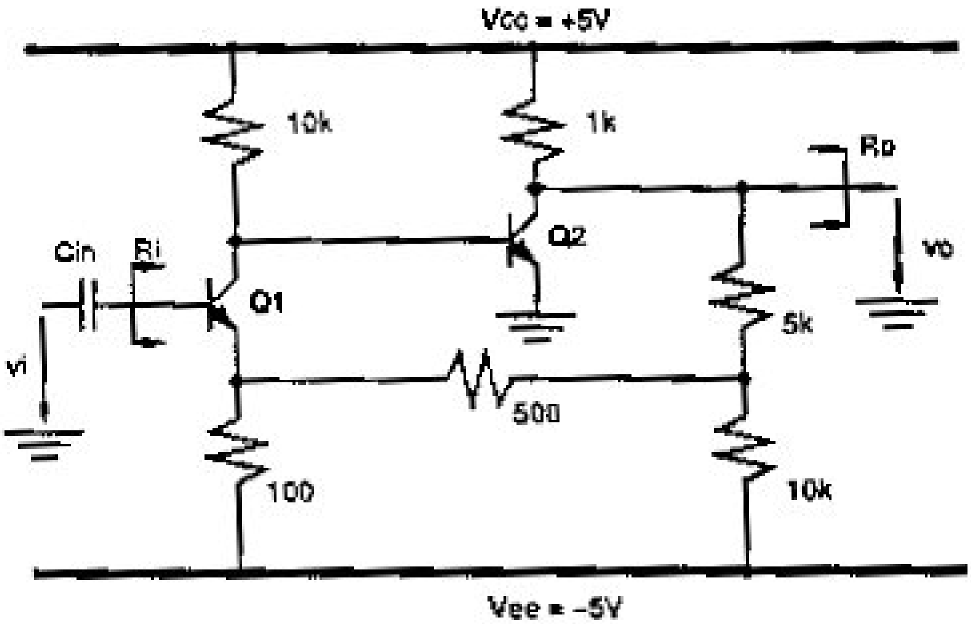
Device Parameters: (unless otherwise indicated)

NPN:	$I_s = 5x10^{-15}A$, $\beta_F = 100$, $V_A = 100V$, $V_{BE(on)} \approx 0.7V$, $V_{CE}^{(sat)} = 0.2V$, $C_{je0} = 1pF$, $\tau_f = 0.3ns$, $C_\mu = 0.5pF$
PNP:	$I_s = 2x10^{-15}A$, $\beta_F = 50$, $V_A = 50V$, $V_{BE(on)} \approx -0.7V$, $V_{CE}^{(sat)} = -0.2V$, $C_{je0} = 0.5pF$, $\tau_f = 20ns$, $C_\mu = 0.5pF$
NMOS:	$\mu_n C_{ox} = 50\mu A/V^2$, $V_{th0} = +0.7V$, $\lambda_n = 0.02V^{-1}$ @ L = 4um, $\gamma_n = 0.4sqrt(V)$, $2\Phi_f = 0.6V$
PMOS:	$\mu_p C_{ox} = 25\mu A/V^2$, $V_{th0} = -0.7V$, $\lambda_p = 0.05V^{-1}$ @ L = 4um, $\gamma_p = 0.6sqrt(V)$, $\lvert 2\Phi_f \rvert = 0.6V$
$V_T \approx$	26 mV (300 K)

Problem #1

In the amplifier shown below a dc biasing circuit (no shown) makes that the large signal output voltage is $V_o = 1V$. C_i is a large coupling capacitor. Assume that the circuit is compensated to ensure stability.

(a) what is the type of feedback used?
(b) what is the feedback factor, *f*?
(c) what is the loop gain, *T*, at low frequence?
(d) what is the low-frequency, small-signal voltage gain v_o/v_i of the circuit?
(e) what is the low frequency input resistance, R_i?
(f) what is the low frequency output resistance, R_o?



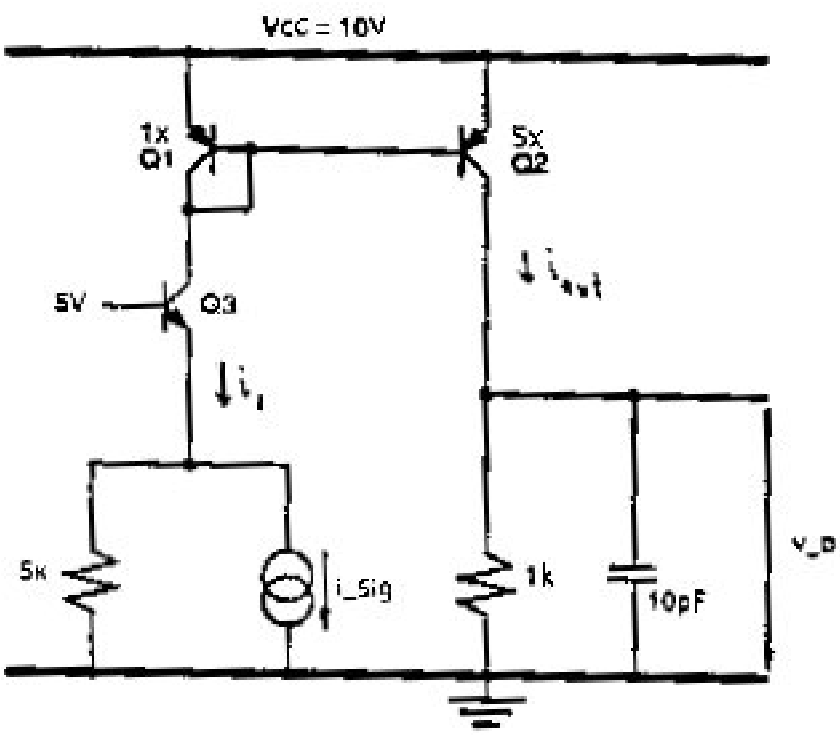
Problem #2

For the circuit below, find

(a) the low-frequency transresistance $R_x = v_o/i_{sig}$, and

(b) the bandwidth $f_{-3_{db}}$ (use zero valued time constants).

(c) write and expression for the frequency response $V_o(s)/I_{sig}(s)$ (polynomial is s). Include only the dominant pole and ignore zeroes.



Problem #3

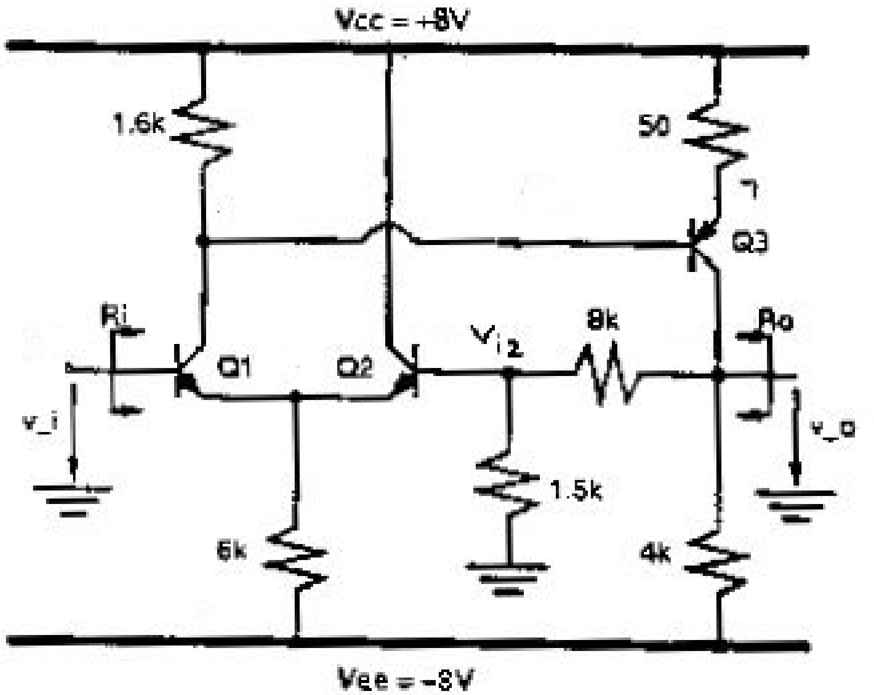
In the amplifier below you may neglect base currents when determining dc conditions.

(a) What is the overall feedback used?

(b) Find the low-frequency loop-gain T_o.

(c) Determine the closed-loop voltage gain, v_o/v_i at low frequencies.

(d) Determine the closed-loop input and output resistances R_i and R_o.



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