B.E. BOSER **Analog Integrated Circuits** **EECS 140**
SPRING 1995

Midterm 2

Thursday, April 6, 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.

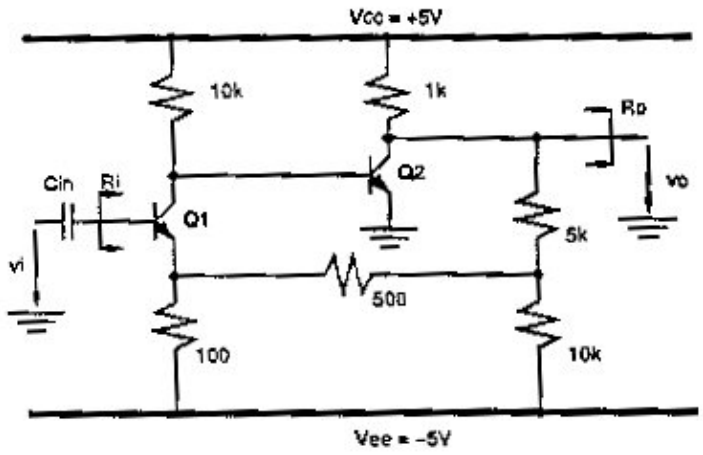
Device Parameters: (unless otherwise indicated)

NPN:	$I_S = 5\text{x}10^{-15}$A, $\beta = 100$, $V_A = 100$V, $V_{BE(on)} \approx 0.7$V, $V_{CE}(sat) = 0.2$V, $C_{je0} = 1$pF, $\tau_f = 0.3$ns, $C_\mu = 0.5$pF
PNP:	$I_S = 2\text{x}10^{-15}$A, $\beta = 50$, $V_A = 50$V, $V_{BE(on)} \approx 0.7$V, $V_{CE}(sat) = -0.2$V, $C_{je0} = 0.5$pF, $\tau_f = 20$ns, $C_\mu = 0.5$pF
NMOS:	$\mu_n C_{ox} = 50\mu$A/V^2, $V_{th0} = +0.7$V, $\lambda_n = 0.02$V^{-1} @ L = 4um, $\gamma = 0.4$sqrt(V), $2\phi_F = 0.6$V
PMOS:	$\mu_p C_{ox} = 25\mu$A/V^2, $V_{th0} = -0.7$V, $\lambda_p = 0.05$V^{-1} @ L = 4um, $\gamma = 0.6$sqrt(V), $\lvert 2\phi_F \rvert = 0.6$V
$V_T \approx$	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.

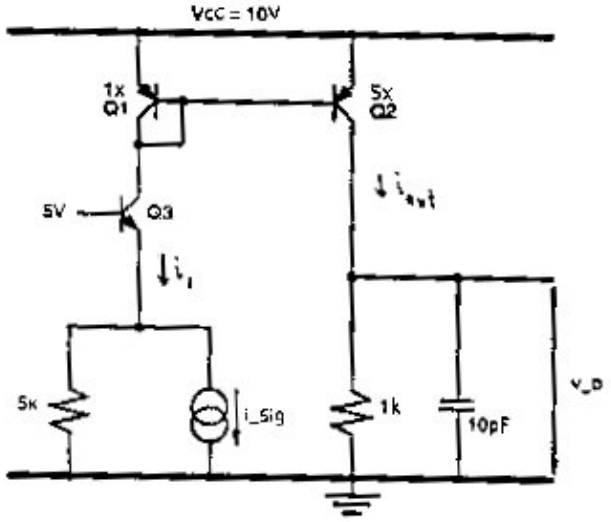
(a) what is the type of feedback used?
(b) what is the feedback factor, f?
(c) what is the loop gain, T, at low frequence?
(d) what is the low-frequency, small-signal voltage gain v_o/v_i of the circuit?
(e) what is the low frequency input resistance, R_i?
(f) what is the low frequency output resistance, 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_{-3db} (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.