Name: ______________________________

Student No: ______________________________

Electrical and Computer Engineering Department
University of Puerto Rico - Mayaguez, P.R.
Electronics II - Spring 1999 - Final Exam - Prof. Manuel Toledo

1. For the oscilator circuit shown below, the two transistors have $g_m = 1.6mA/V$. Each part below is 5 points.

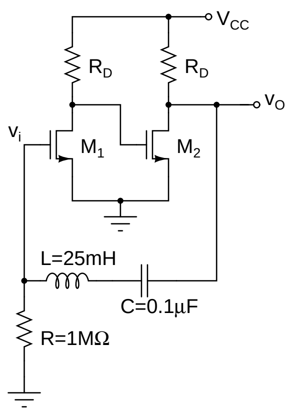
   (a) Draw a diagram of the phase shift network.

   (b) Find $\beta(s) = \frac{v_i}{v_o}$ from the diagram drawn in part (a).

   (c) Determine the loop gain, $A(s)\beta(s)$. HINT: THE GAIN WILL DEPEND ON THE PHASE SHIFT NETWORK.

   (d) Apply the Barkhausen Criterion to find the frequency of oscillation.

   (e) Find the minimum value of R_D that would satisfy the Barkhausen Criterion.



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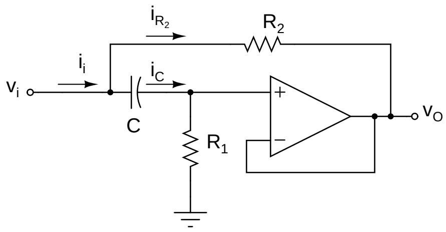
2. Determine the input impedance $Z_{in} = \frac{v_i}{i_i}$ for the following circuit. Assume an ideal opamp. HINT: FIND THE GAIN FIRST. (25 points)



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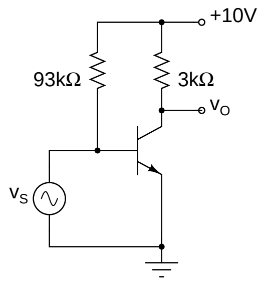
3. Determine the high cutoff angular frequency, w_H, for the following circuit. The input voltage source is ideal. HINT: YOU DON'T NEED β TO ANSWER THE QUESTION. DRAW THE AC EQUIVALENT CIRCUIT WITH THE TRANSISTOR REPLACED WITH ITS MODEL AND THINK. (25 points)



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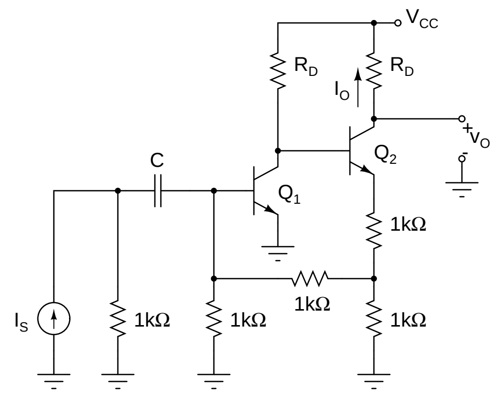
4. The sketch shown below is a diagram of a feedback amplifier. HINT: FEEDBACK TYPE IS CURRENT-SHUNT.

   (a) Draw a diagram of the feedback network. (5 points)

   (b) Find the feedback's network β. (5 points)

   (c) Estimate an approximate value of the feedback amplifier's gain. HINT: ASSUME THAT THE NON-FEEDBACK AMPLIFIER GAIN IS VERY LARGE. (5 points)

   (d) Draw a diagram of the non-feedback amplifier, including the loading effects of the feedback network. Include numeric values for the resistors. Do not replace the transistors by their model. (10 points)



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	Voltage Series	Current Series	Current Shunt	Voltage Shunt
Feedback signal	voltage	voltage	current	current
Sampled signal	voltage	current	current	voltage
Signal source	voltage	voltage	current	current
model	h	z	g	y
β	$\frac{v_1}{v_2}\big\|_{i_1=0}$	$\frac{v_1}{i_2}\big\|_{i_1=0}$	$\frac{i_1}{i_2}\big\|_{v_1=0}$	$\frac{i_1}{v_2}\big\|_{v_1=0}$
A_f	$\frac{A_V}{1+\beta A_V}$	$\frac{G_M}{1+\beta G_M}$	$\frac{A_I}{1+\beta A_I}$	$\frac{R_M}{1+\beta R_M}$
R_{if}	$R_i(1+\beta A_V)$	$R_i(1+\beta G_M)$	$\frac{R_i}{1+\beta A_I}$	$\frac{R_i}{1+\beta R_M}$
R_{of}	$\frac{R_o}{1+\beta A_V}$	$R_o(1+\beta G_M)$	$R_o(1+\beta A_I)$	$\frac{R_o}{1+\beta R_M}$

Table 1: Feedback amplifier formulae.

model	h	z	g	y
input source	Thevenin	Thevenin	Norton	Norton
output source	Norton	Thevenin	Thevenin	Norton
11	$\frac{v_1}{i_1}\big\|_{v_2=0}$	$\frac{v_1}{i_1}\big\|_{i_2=0}$	$\frac{i_1}{v_1}\big\|_{i_2=0}$	$\frac{i_1}{v_1}\big\|_{v_2=0}$
12	$\frac{v_1}{v_2}\big\|_{i_1=0}$	$\frac{v_1}{i_2}\big\|_{i_1=0}$	$\frac{i_1}{i_2}\big\|_{v_1=0}$	$\frac{i_1}{v_2}\big\|_{v_1=0}$
21	$\frac{i_2}{i_1}\big\|_{v_2=0}$	$\frac{v_2}{i_1}\big\|_{i_2=0}$	$\frac{v_2}{v_1}\big\|_{i_2=0}$	$\frac{i_2}{v_1}\big\|_{v_2=0}$
22	$\frac{i_2}{v_2}\big\|_{i_1=0}$	$\frac{v_2}{i_2}\big\|_{i_1=0}$	$\frac{v_2}{i_2}\big\|_{v_1=0}$	$\frac{i_2}{v_2}\big\|_{v_1=0}$

Table 2: Two-port network formulae.