Name: SOLUTION (please print)

Signature: ____________________

ECE 3455
Quiz #1
Summer 2010

Quiz duration: 25 minutes

1. You may have one 8 ½ x 11 in. "crib" sheet, written on both sides, during the quiz. You may have any calculator you choose, but no computers. No other notes or materials will be allowed.
2. Show all work necessary to complete the problem on these pages. A solution without the work shown will receive no credit.
3. Show units in intermediate and final results, and in figures.
4. If your work is sloppy or difficult to follow, points will be subtracted.

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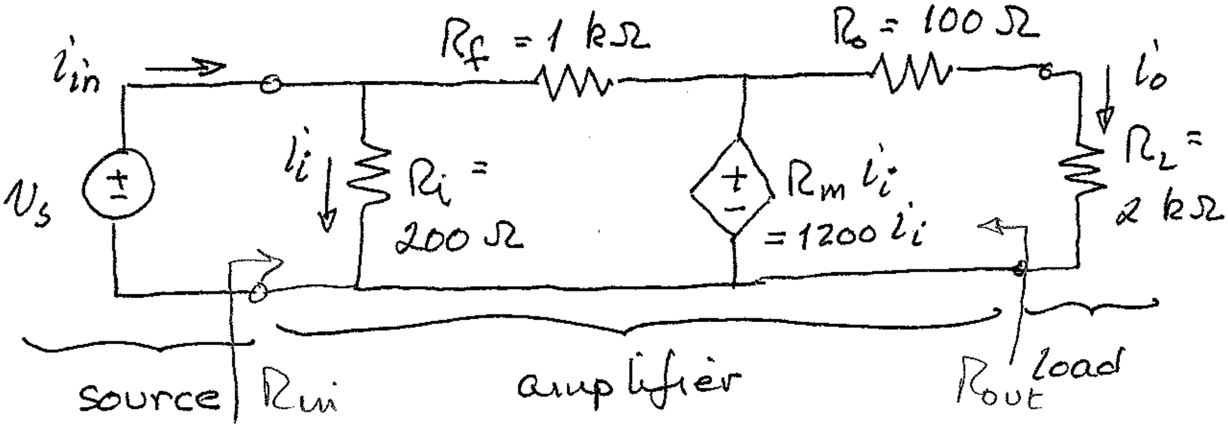
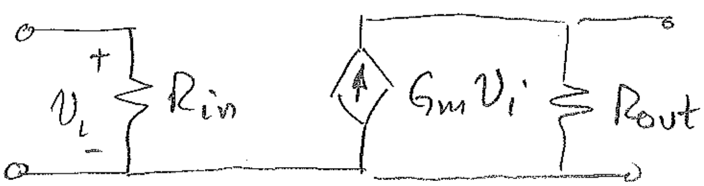
The figure below shows a source, amplifier, and load. The source resistance is 0.

i. Find the parameters of a single transconductance amplifier that is equivalent to the amplifier shown. Draw the equivalent transconductance amplifier. Clearly label all parameters and show their values.

ii. Find the current gain i_o/i_{in}.



i) The equivalent transconductance amplifier is:



We will need to find R_{in}, R_{out}, & G_m.

R_{in}: Looking at the transresistance amp:

$$R_{in} = \frac{V_s}{i_{in}} \qquad i_{in} = \frac{V_s}{R_i} + \frac{V_s - R_m i_i}{R_f} = V_s\left(\frac{1}{R_i} + \frac{1}{R_f} - \frac{R_m}{R_f R_i}\right)$$

$$i_i = \frac{V_s}{R_i} \qquad \text{So } R_{in} = \left(\frac{1}{R_i} + \frac{1}{R_f} - \frac{R_m}{R_f \cdot R_i}\right)^{-1}$$

Plugging in numbers...

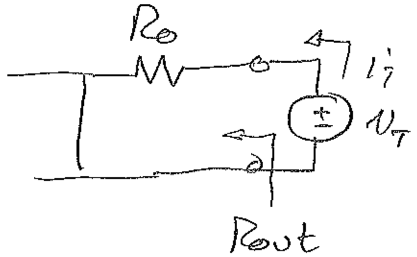
$$R_{in} = \left(\frac{1}{200} + \frac{1}{1000} - \frac{1200}{1000(200)}\right)^{-1} = \infty\ !$$

Room for Extra Work

So R_m has been adjusted for infinite input resistance.

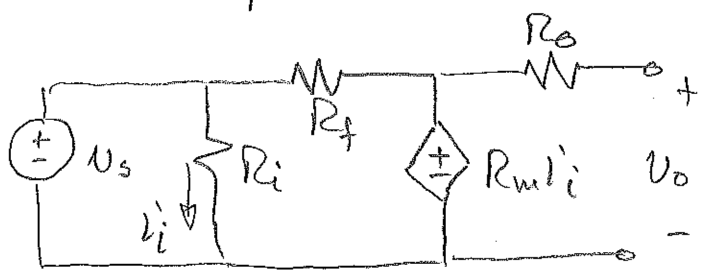
R_o: Putting a test source at the output and setting $v_s = 0$, we have:

$$v_s = 0 \Rightarrow i_i = 0 \Rightarrow R_m i_i = 0$$



$\Rightarrow R_{out} = R_o$

Finally, we look at the open circuit voltage at the output:



$$v_o = R_m i_i = R_m \frac{v_s}{R_i}$$

For the transconductance amplifier:

$$v_o = G_m v_i R_o = G_m v_s R_o \Rightarrow G_m = \frac{R_m}{R_i R_o}$$

$$\therefore G_m = \frac{1200}{200(10.0)} = 0.060 \text{ S}$$

ii) Since $i_{in} = 0$ (because $R_{in} = \infty$), $\frac{i_o}{i_{in}} = \infty$