Name: _____ (please print)

Signature: _____

ECE 3455
Quiz #1
Fall 2010

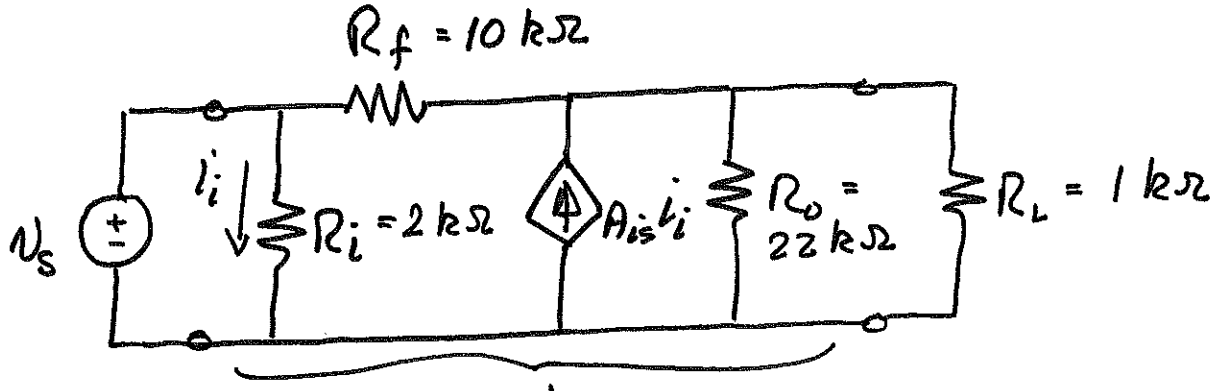
Quiz duration: 30 minutes

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.

_____/20

Room for Extra Work

The figure below shows a source, amplifier, and load. Find the parameters of a single amplifier (any type you choose) that is equivalent to the amplifier shown. Draw the equivalent amplifier. Clearly label all parameters and show their values.



$A_{is} = 1.5\ A/A$

Room for Extra Work

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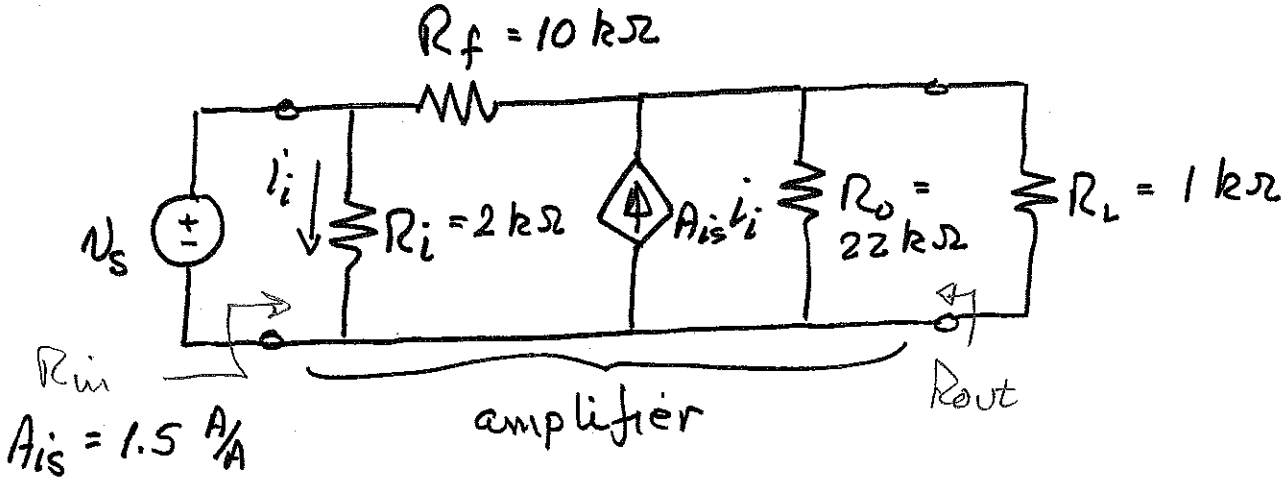
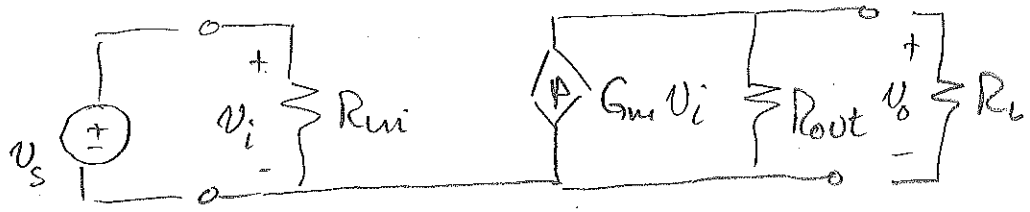
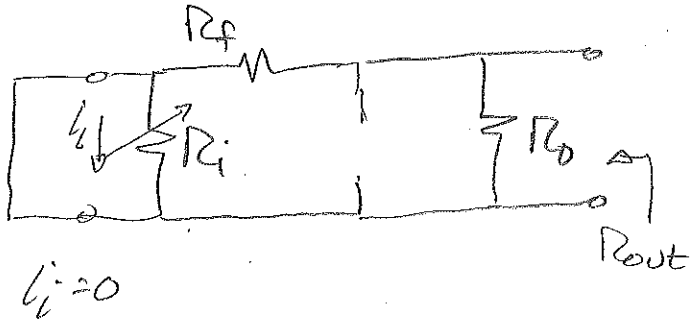


We will choose a transconductance amplifier, but this is an arbitrary choice.



We need the input and output resistances of the original amp, as well as G_m.

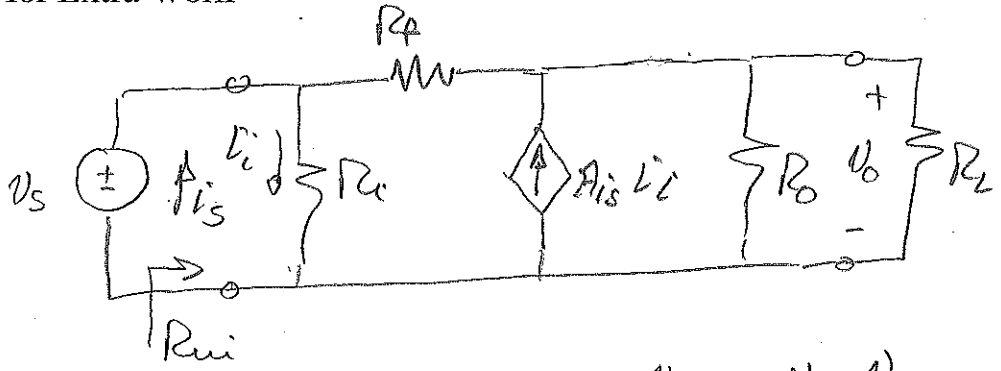
R_{out}: With a test source at the output and $v_s \to 0$, we have:



$$R_{out} = R_o \parallel R_f$$
$$= 6.875\ k\Omega$$

Room for Extra Work

R_{in}:



$$R_{in} = \frac{v_s}{i_s} \qquad i_i = \frac{v_s}{R_i}$$

$$\frac{v_o}{R_o} + \frac{v_o}{R_L} - A_{is}\frac{v_s}{R_i} + \frac{v_o - v_s}{R_f} = 0$$

$$v_o\left(\frac{1}{R_o} + \frac{1}{R_L} + \frac{1}{R_f}\right) = v_s\left(A_{is}\frac{1}{R_i} + \frac{1}{R_f}\right)$$

$$\therefore v_o = v_s \frac{A_{is}/R_i + 1/R_f}{\frac{1}{R_o} + \frac{1}{R_L} + \frac{1}{R_f}} = 0.742\, v_s$$

+11

$$i_s' = \frac{v_s}{R_i} + \frac{v_s - v_o}{R_f} = v_s\left(\frac{1}{R_i} + \frac{1}{R_f} - \frac{0.742}{R_f}\right)$$

$$\frac{v_s}{i_s} = R_{in} = \left(\frac{1}{R_i} + \frac{1}{R_f} - \frac{0.742}{R_f}\right)^{-1} = 1902\ \Omega$$

Finally, we have $v_o = 0.742 v_s$ for the original amp, and with the same load, for the equivalent,

+5

$$v_o = G_m v_s \cdot \frac{R_{out}}{R_{out}+R_L} R_L = 0.742\, v_s$$

$$\Rightarrow G_m = \frac{R_{out}+R_L}{R_{out}R_L} \cdot 0.742 = 8.5\times10^{-4}\ S$$